"On the Escape of Tigers," William Haddon, Jr., M.D.—an essay on strategies for reducing the ecologic damage from energy transfer phenomena

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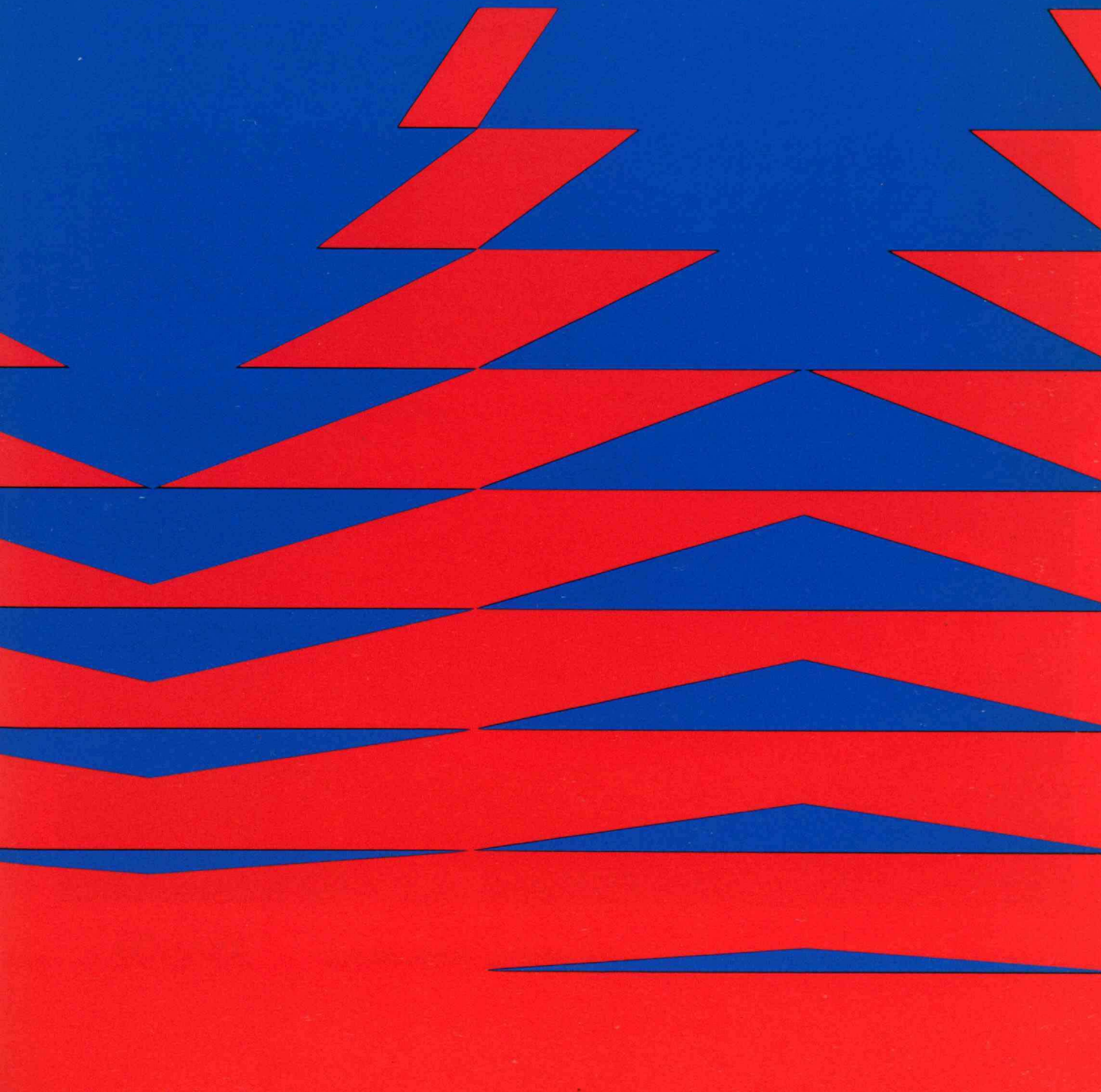
"Memorandum to a Vietnam Negotiator," Jerome B. Wiesner
"To Select a Leader," Hrand Saxenian
"Industrialized Building," J. Karl Justin
"Reliability: How to Command Success," William G. Denhard

Technology Review



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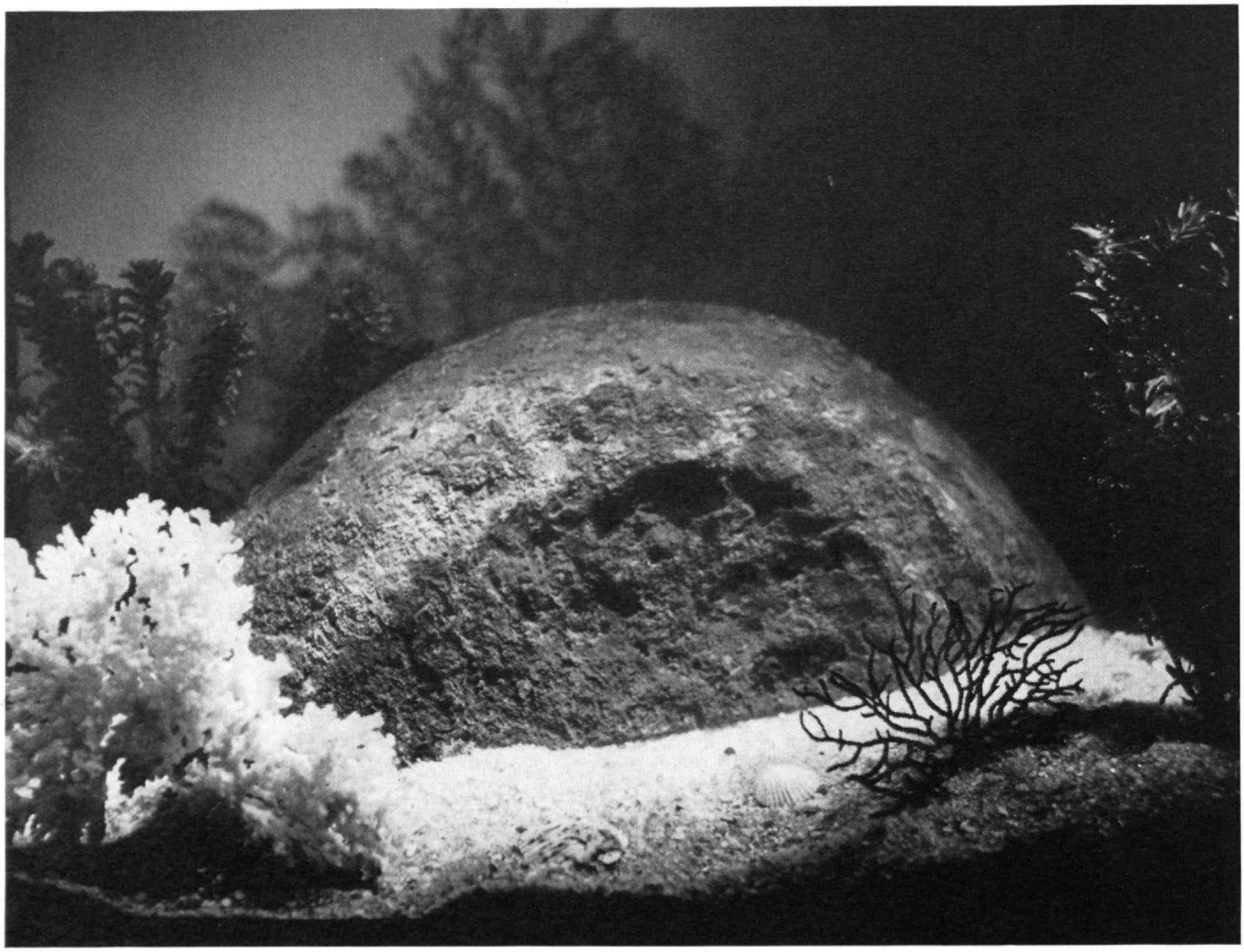
The excellent condition of this casting, salvaged from a sunken Roman ship after nearly 2,000 years at the bottom of the Mediterranean, testifies to the indestructible nature of copper. This casting was recently assayed 99.2 per cent copper.



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The First Line

There may yet be risks in writing any final judgment of events of January 14 and 15, when the offices of the President and Chairman of M.I.T. were occupied by a group of young people intent on setting aside earlier disciplinary actions—and on winning support for their radical causes (*see* Technology Review *for February, pp. 72A-D*). But the case holds lessons whose significance goes far beyond the confines of M.I.T., and to point them out is surely worth some peril.

When Judge Haven Parker abruptly ended the trial of 25 of these intruders on March 10, he voided an effort of the defendants to turn his courtroom into an arena for ridicule of the American judicial system. He also left the prosecutors and M.I.T. witnesses frustrated with no place to argue their well-planned case. But it is significant that in connection with his probation ruling, Judge Parker entered into his record the statement that "the evidence warrants a finding of guilty" against all the defendants.

No student strike in support of the defendants, no broadly based community effort to gain them amnesty has since materialized in Cambridge.

During their 30 hours in the President's offices, the intruders found themselves increasingly isolated from less radical colleagues on whom they counted for support, and in the same period M.I.T. accumulated evidence against them of a kind which could never have been acquired during a forcible eviction.

When at last the intruders saw their position untenable, they left behind a record which made their guilt clear to Judge Haven Parker even as the trial had barely begun. In no case where police action has been required on a college campus has there remained a clearer record of those truly guilty of threats and coercion against the principles of freedom and justice upon which the excellence of American academic institutions have been built.

This is not to draw comparisons between M.I.T. and any other institution, where similar events may have compounded themselves very differently. It is simply to say that the flexibility of mind and hand which made it possible for M.I.T. to chart its own course without dictation by police or by arbitrary law made not for irresponsibility but for sensitive and appropriate firmness.—J.M.

Editorial Adviser
Careful readers of this page may have noted the addition two months ago of a new name to the roster of the *Review's* Editorial Advisory Board. We welcome Arthur J. Snider, Science Editor of the *Chicago Daily News,* with enthusiasm. He was one of the first specialists in newspaper science writing, served many years ago as President of the National Association of Science Writers, and continues to view the science scene with the pragmatic realism of a practicing journalist. His counsel will be invaluable in these editorial rooms.

Next Month
For June, *Technology Review* announces:

"Chemical Descriptions of the Oceans," by Edward D. Goldberg, Professor of Chemistry at the Scripps Institution of Oceanography—how man is beginning to influence the chemical composition of the ocean, despite their vastness, and what may be the consequences.

"Operations Research in Law Enforcement," by Albert M. Bottoms, Research Associate at the Harvard-M.I.T. Joint Center for Urban Studies—an account of the principles of operations research used to increase the effectiveness of Chicago's Police Department.

"What Kind of Transport Will the Urban Public Use?" by Martin Wohl, Director of Transportation Studies for the Urban Institute—how the taste of the traveling public is changing—and how these changes must affect plans for future transportation networks.

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Cambridge Journal

No. 7 in a series

David W. Corson from A. Devaney, N.Y.

At NREC smoke is a no-no...

Recent interest in power sources which cause less pollution than the internal combustion engine has led to the careful evaluation and consideration of the gas turbine engine as an attractive alternative. Major manufacturers of powerplants and vehicles are actively developing gas turbine engines for vehicular and other applications and are already testing prototypes on the highways. The vehicular gas turbine of the future must be economical to manufacture, inexpensive to operate, easily serviceable, and should be designed to improve on what is already regarded as a low contribution to atmospheric pollution levels.

The small gas turbine has played a significant role in NREC technical activities for several years. Our efforts have been directed toward the achievement of significant advances in the design technology of gas turbine components, in engineering research in disciplines such as combustion, fluid mechanics, heat transfer, and solid mechanics, in manufacturing cost studies for economic gas turbine power plants, and toward the development of high-efficiency turbomachinery components. These activities have been directed toward the significant objective of eventually developing a low-cost, efficient gas turbine power plant. Current programs include applied research in high-pressure ratio centrifugal compressor stages, investigations of flow problems in axial turbines, the design and development of compact low-emission combustors, and studies of nitrogen oxide emissions from gas turbines.

If you are interested in more information about the potential applications of gas turbine power plants to highway and other applications, you are invited to write to the Marketing Department, Northern Research and Engineering Corporation, 219 Vassar Street, Cambridge, Massachusetts 02139, or call 617 491-2770.

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Or, for that matter, is Los Angeles? Or Chicago? Or Philadelphia? Or Dallas?

Or any other city groping its way to an uninhabitable anachronism.

A curious situation has developed in America. Eighty per cent of the people in this country live on less than ten per cent of the land area.

There used to be a good reason for this.

At the time of the industrial revolution, we congregated in cities because that's where the sources of energy were. Coal. Water. Electricity.

And our communications network was so limited that we had to be in close proximity to each other for business and social purposes.

No more.

There are no longer any good reasons to continue this hopelessly outmoded life style.

With the advent of the whole spectrum of new communications available to us (wide-band communications, laser beams), we will have the opportunity to live in significantly less dense population centers.

This is no idle prophecy.

The concept is quite realistic and well within the bounds of engineering capabilities which we already have.

Not only do we have the tools to provide the means for new styles in human settlements, but also to rebuild, in a sociological sense, the crowded inner core of our major cities.

The combination of international satellites and cable will provide the means of bringing individuals all the information they need or want without interference or control.

And without the need to be in any specific place.

(Think for a moment about the Apollo 11 moon landing in July, 1969. 500 million people around the world saw, via television, *precisely the same thing at the same time.* Being in New York or Los Angeles held no advantage over being in Keokuk or Harrisburg.)

Historically, we've been preoccupied with moving people and objects. Thus, our intricate network of highways and railroads and airlines — all of which have become enormously inefficient (not inherently, but in application).

The future will see us moving *information,* not, by necessity, people and things.

Your home will be the absolute center of your life.

You will work from home, shop from home, "visit" with family and friends from home, receive in your home any intellectual or cultural achievement known to man.

Fantastic, yes. Fantasy, no.

It is quite within reason to expect these changes by the 1980's.

If we want them.

If we want to change. If we want a better life for ourselves.

Technology has advanced to such an extent, that man is now, literally, capable of changing his world.

Yet, today, a certain gap has developed between the potential of technology and its use by mankind.

There is an obvious contradiction in a method which can land a man on the moon, yet tolerates, perhaps even accepts as inevitable, poverty and ignorance here on earth.

There is a contradiction in a method which affords the best of everything for some, and next to nothing for others.

So we must, in a sense, catch up with the technological potential and apply it for the benefit of all mankind.

All we need sacrifice are the antiquated work practices and our anachronistic traditions.

At RCA, through research and product development, we are committed to closing the technology gap and cancelling the contradictions.

This is the age of the engineer. Nobody understands this better than RCA.

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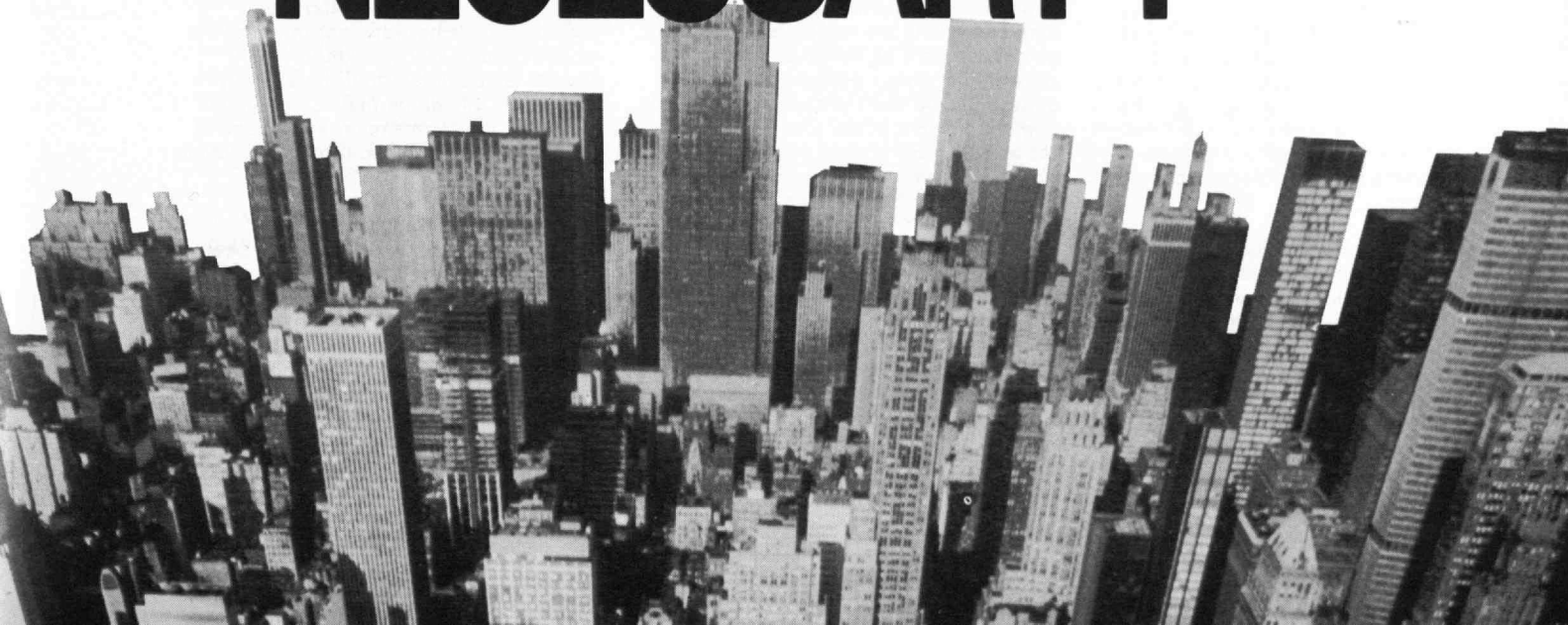
IS NEW YORK REALLY NECESSARY?



A hostile public climate has been developing for science for over a decade. Now the scientists, as well as the poets, are asking why their image is crumbling and what can be done about it

How Many Nonscientists Are Listening?

Medieval sorcerers filled contemporary laymen with fear, often with loathing. The old belief in their powers inspires modern scientists to contempt. How awkward that scientists now have to face the fact that they too often fill their contemporaries with revulsion.

"It is incredible, but true, that science and its technologies are today on the defensive," Oak Ridge National Laboratory director Alvin Weinberg told the Association of German Scientists in Munich last October.

"My generation of scientists has . . . mined the new knowledge that is the foundation of the modern world. . . . Yet today I hear very little singing. . . . [Critics claim] that we are replacing nature as the prime enemy of mankind," Merck Vice-President Max Tishler lamented in accepting the American Chemical Society's Priestley Medal in Houston in February.

And in London more recently, one of Britain's top science educators and planners, Frederick S. Dainton, observed that scientists face "feelings of helplessness combined with jealousy among nonscientists."

So flows the current of anxiety underlying the scientific establishment today. You could, of course, sense this hostile public climate developing for over a decade. Now even the Daintons, Tishlers, and Weinbergs are alarmed.

Dr. Dainton, now quitting as Vice-Chancellor of the University of Nottingham, has been mulling over this threat to science in connection with his new job as Chairman of Britain's Council for Scientific Policy. Chatting about this, he noted, "There is a very prevalent view that application of science and technology creates more problems for society than it solves. . . .

"Many outside of science think that scientists determine the course that application of their knowledge takes. Of course, they don't. Government, industry, and the public all are involved. Then too, some think science has its own momentum, a driverless bus going its own way out of control. Also, there's the literal picture of the scientist, held particularly by young people—a dry-as-dust man in the laboratory withdrawing himself from human contact, someone you'd never befriend, not concerned with society, proceeding in a logical manner to uncover 'knowledge' that will be used he doesn't care how: not at all a human person."

Poet Robert Graves has added yet another facet to the stereotype in an interview in UNESCO's magazine *Impact of Science on Society*. He said he thinks scientists' wives feel "a sense of frustration . . . because the husbands live . . . in an exclusive world in which things are viewed in a strange and different way. . . . In a metaphorical sense you might say they are shooting at the moon and evading the human ties of earth."

Shades of a survey carried out by the American Chemical Society many years ago! It revealed even then, widespread among American high schoolers, the concept of a scientist so colorfully sketched by Dr. Dainton. These teenagers probably have grown up to join the scientists' opposition.

A Driverless Bus?

Dr. Dainton says scientists can blame themselves for their crummy image. They teach their subjects in dull, step-by-step fashion because it's convenient to do so, even though it reflects nothing of the helter-skelter thrill of the genuine quest for knowledge. Scientists don't work like that at all. "Scientists work on hunches," Dr. Dainton explains. "Scientists and artists are not so far apart. You go at your work as the artist goes at his. He works in lines on paper, say. It's not quite right. He can't always say rationally why it isn't right at the time; neither can the scientist, but it's not quite right. He rips off the paper and starts again. Eventually it clicks. 'Right,' he says, 'that's it.' I do that too."

Why don't scientists present themselves as they really are? Dr. Dainton asks. They seem to work at projecting a dull image, he says, reinforcing it particularly by writing and lecturing in a "learned" manner that puts even their colleagues to sleep.

Too true, but there's more to the making of a bad image than style. Some scientists, writing or speaking with lucidity and verve, send a chill through the antiscience skeptics.

There's nothing turgid about a recent article in the journal *New Scientist* by famed nuclear physicist Edward Teller. Under the title "Can a Progressive Be a Conservationist?" he vigorously argues "No," especially where industrial use of nuclear explosives is concerned. He evoked the comment from one reader, "Here we have a scientist who can see no further than his specialist views. No wonder the ordinary person feels that science is utterly beyond him. . . . Some believe that science is dragging an unwilling world out of its primitive state into a wonderful scientific paradise. Perhaps it is that the world just does not want to go where the progressive scientists want it to go . . . "

Is the public really so wrong to regard science more as a driverless bus on which the world rides than as merely a creative outlet? Even Dr. Dainton admits that "being a scientist is different from being a Van Gogh" since "science gives tremendous power over nature." And as Dr. Tishler noted in Houston, you can't leave the issue with the escapist notion that knowledge is neutral, that only its use involves moral judgments.

"If you follow Einstein's equation all the way through from its conception to the present, you will be forced to conclude that each step was inevitable . . . ," he said. "Atomic fission was too much power—war or no war—not to tempt the modern state." He went on to ask if anyone is "confident that there is any society on this globe that . . . is ready to handle the forthcoming knowledge of genetics with wisdom and for the ultimate benefit of man?"

Rebalancing the Scales

Each of the three "wise men" I've been quoting has his view of what the scientist's role should be in this situation.

Dr. Tishler maintained, "It is not knowledge but man himself who is the weak link in the continuum from the discovery of knowledge to its first use [or mis-

Title-page illustration used in various early editions of Marlowe's Tragicall History of the Life and Death of Doctor Faustus. *It presumably depicts Mephistopheles' first entry—and exit—when Faustus orders him to return in a more attractive shape. Faustus, gratified by this show of cooperation, exclaims: "How pliant is this Mephistophilis, full of obedience and humility!"*

use]." Since it will take massive new knowledge to right the bad effects of past misuse, he feels humanity has no alternative to letting scientists "go down the trail of basic research to its end, devising simultaneously the unprecedented controls" needed to use their discoveries wisely.

Scientists, he feels, must work closely with the public "to find a way to rebalance the scales between the growing power of scientific knowledge and the continuing weakness of man." And he warns that, unless scientists do exert vigorous leadership in this, "we may soon wake up to find not only that technology has been crudely shackled but that fundamental scientific inquiry itself is in jeopardy" because "public opinion is overtaking and may swamp us."

For his part, Dr. Dainton insists, "The scientist does science partly because it's the only way human beings can study their relationship to space, time, and the natural world, and find their natural role in the universe. You can't stop it. So the scientist's role is not to not do science. But it is to point out to society, to legislators, to government what the consequences of his knowledge are just as soon as he knows what they are. His social role is to create the information background against which decisions can be more intelligently taken."

Dr. Weinberg joins in proclaiming that "clarification, if not resolution, of our great social problems, . . . calls for more, not less, science and technology." "Yet," he explained to the German scientists, "to a very noisy and, I fear, influential group of younger intellectuals such attempts to inject more science into our social planning and thinking are anathema. To some extent this antiscientific fashion has infected much of our youth, as well as other parts of society."

He acknowledges that "the technologies that have sprung from our modern science are 'tainted' " by bad side effects; and he asks, "Is it not clear that the social responsibility of the technologist and his scientific supporters lies in removing the taints that now mar the modern technologies of abundance?

"To me then," he concludes, "the job and the purpose of science and technology remain overwhelming: to create a more liveable world, to restore man to a state of balance with his environment, to resolve the remaining elementary and primitive suffering of man. . . . It is the height of irrationality to turn our backs on all this, as is urged by the more radical of the scientific abolitionists."

What a dilemma! Never before have scientists and the rest of humanity needed to cooperate more, to understand and trust one another. Never before have they seemed so alienated.

The Deaf Majority

Dr. Dainton says he hasn't got "any recipe for correcting this sort of thing. I think we are in a difficult situation. I think there is an adverse climate. And I think it is good for us [scientists]. . . . The only thing that will put this right is for scientists to come out of their shells and be seen as human beings. I'm afraid a lot of us have got to stop being back room boys."

I wish him luck. Some scientists, and science writers, have been trying to point out the social consequences of science for decades without getting through to the deaf majority. Dr. Dainton is right to say, "It's not the scientists who cut themselves off, but the nonscientists who refuse to have anything to do with them."

He's also right to insist that to reject science is to reject some of the greatest riches of human heritage. As he says, "science is an immensely human activity." He explains, "It is one of the greatest humanities. It doesn't deal directly with social values. But, by golly, it helps a man to know himself." I wonder how many nonscientists are listening.

Robert C. Cowen, Science Editor of the Christian Science Monitor, *is stationed in England. A graduate of M.I.T., he writes regularly for* Technology Review *and serves as well as a member of its Editorial Advisory Board.*

European Report
Daniel S. Greenberg

Britain is proposing a unique experiment which merits "sympathetic notice" in the U.S. even if emulation is unthinkable: in a socialist country, the government research and development laboratories may be conveyed to a new private corporation which forces them to earn their keep

Can Government Research Survive in the Market Place?

Britain is seriously considering a plan to group some of its major government laboratories into a quasi-independent corporation and require them to earn their support principally by selling services to government and industry.

The proposal, put forth by the Ministry of Technology, is the latest in a series of moves motivated by Britain's galling combination of low industrial productivity and well-developed scientific and technical resources. Among the latter is a costly network of government-owned and operated research establishments. As is often the case with national laboratories in other countries, doubt exists as to whether they have not lived beyond the purpose for which they were created, but there is no doubt that they possess remarkable immunity to being killed off or redirected.

Whether the Ministry's proposal—contained in a pamphlet entitled "Industrial Research and Development in Government Laboratories: A New Organization for the Seventies"—will be carried through is not certain at this point. Opposition is already gathering among the Civil Service staff employed in the laboratories, which, under the proposal, would be free of Civil Service regulations; also, industry has responded to the proposal with an attitude of suspicion, apparently based on little more than the feeling that the Labor Government can only be up to no good.

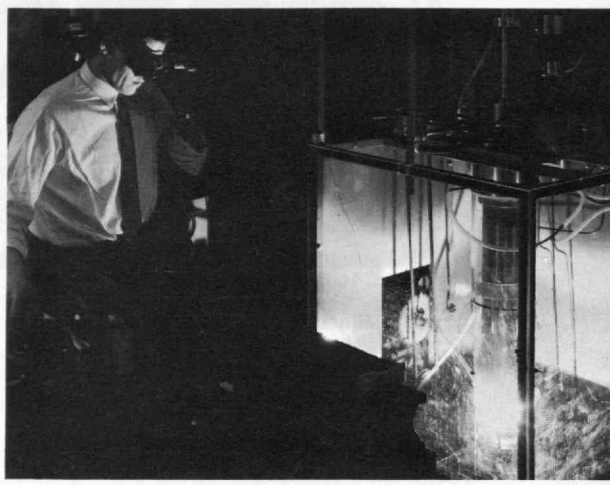
Britain is virtually devoid of the big industrial consulting laboratories that are familiar in the United States, and the proposed organization could provide industry with some sorely needed services that, for whatever reason, are seriously lacking at present. Nevertheless, the Confederation of British Industries, roughly the counterpart of the National Association of Manufacturers, has expressed its opposition.

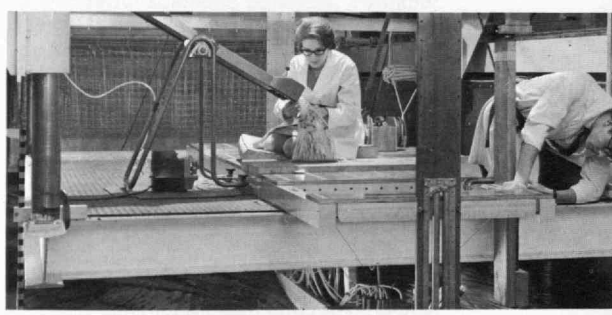
Paying as a "Healthy Discipline"

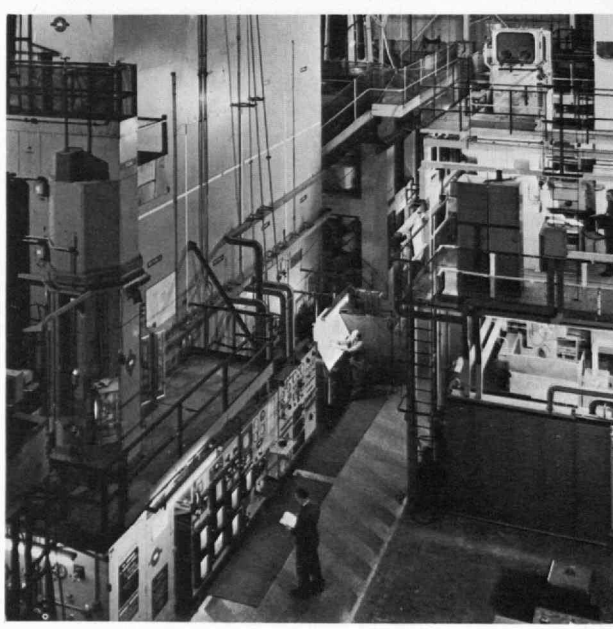
In any case, if the plan goes through it will be a notable landmark in the history of research administration, for it is revolutionary by the standards of that normally stodgy field. Under the proposal, a public corporation, tentatively titled the British Research and Development Corporation (B.R.D.C.), would be created out of some dozen research establishments that currently employ about 4,750 professionals and annually spend nearly $170 million—mainly in applied research. The largest part would come from the United Kingdom Atomic Energy Authority, which has conducted a losing—but brilliantly protracted—campaign against past reorganization efforts. From the A.E.A., which comes under the jurisdiction of the Ministry of Technology, the B.R.D.C. would encompass the 1,450-member research staffs of the Harwell Research Establishment and Culham Laboratory, plus another 1,750 that are attached to the various reactor research establishments and minor facilities of the A.E.A. (In the meantime, under an altogether separate reorganization scheme, the A.E.A.'s production facilities are to be spun off into two commercial companies.)

The B.R.D.C. would also take in the National Physical Laboratory, the National Engineering Laboratory, the Warren Spring Laboratory, and two smaller research facilities, the Hydraulics Research Station and the Forest Products Research Laboratory. Also appended to the B.R.D.C. would be the National Research Development Corporation, a government body that was set up 20 years ago to help provide risk capital in the field of advanced technology.

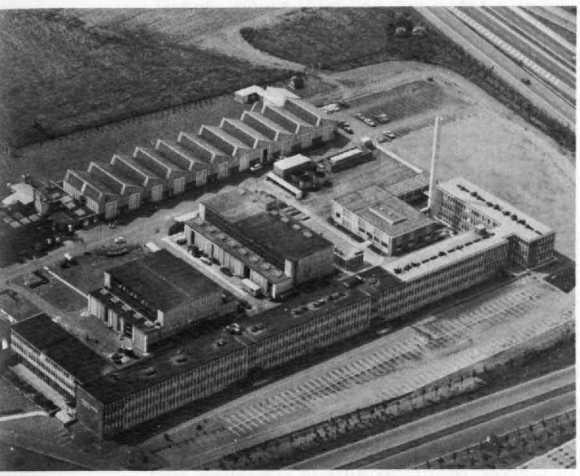
The B.R.D.C. would be headed by a government-appointed board and, the proposal acknowledges, research for government agencies would comprise the bulk of its work. But, in obvious reaction to the belief that government laboratories are generally too insulated from the profit motive, the Ministry proposes that even work for government be put on a contract basis, arguing that "it would be a healthy discipline for departments and organizations to have to pay directly for the programs they sponsor." Also, "a gradual change to a contractual relationship should help to bring about a marked change of attitude within departments, which will have to pay for the work they want done, as well as within the Corporation, which will have to satisfy its customers." Basic research and several other activities that are difficult to assess in terms of profitability would continue to be financed by government, possibly on a

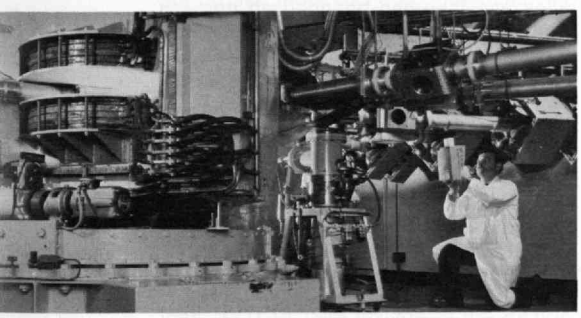


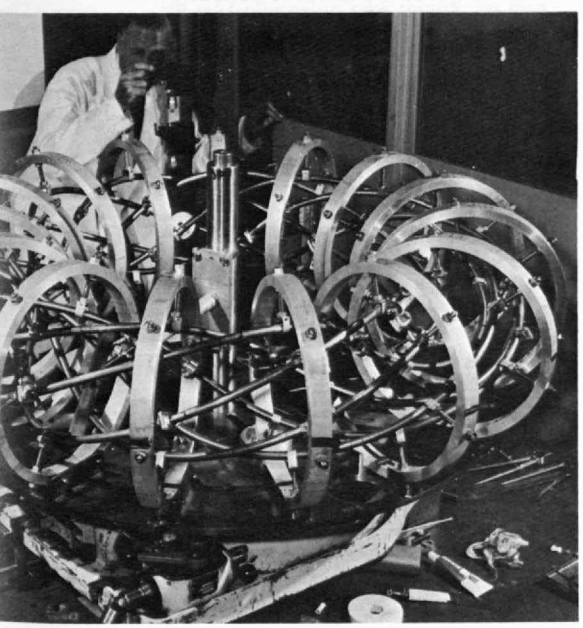




Some of Britain's government laboratories: Left, top and center: a centrifugally-expanded plasma for studying chemistry up to 40,000°K., and a ship model study, both at the National Physical Laboratory (Crown Copyright). Right, top: Warren Spring, a relatively modest multi-purpose establishment (Crown Copyright). The remaining pictures show Atomic Energy Authority laboratories (U.K.A.E.A. Copyright): Right, a variable-energy cyclotron at Harwell and a plasma "stellarator" at Culham; bottom left, sodium-cooled-reactor research at Risley.







grant basis, but the main thrust of the B.R.D.C. would be toward earning its way by performing work desired by its customers.

The U.S., with a many-layered research enterprise linking industry, government, and the universities, could raise many questions concerning the assumption that customer motivation is necessarily a beneficial inspiration for research. But in Britain, where the gap between research and application is considered to be a major cause of industrial sluggishness, few seem to doubt that the economy would benefit from research becoming more profit-minded.

In the industrial field, the proposed corporation is clearly intended to play the role that is profitably occupied by industrial consulting organizations in the United States. Thus, the proposal states that "it is not possible to estimate exactly how much of such work industry would want; but if a new research and development organization were set up which would live to a growing extent on its earnings from contracts, joint ventures, royalty arrangements, etc., its success in meeting the needs of industry would play a part in determining the eventual level at which it operated"—which is perhaps a delicate way of saying "sink or swim."

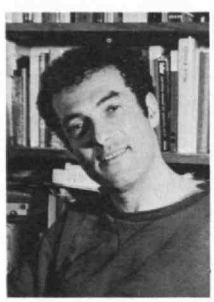
To Shake Things Up a Bit

One of the most important points in the proposal is that the corporation would not be bound by the rigid staffing regulations that are often cited as a cause of drowsiness in government research institutions. Thus, at the outset, government employees who are absorbed into the B.R.D.C. would be protected by the same regulations that apply in their current jobs. In view of the power exercised by trade unions within Britain's scientific and technical ranks, no less than this was to be expected. But one purpose of the B.R.D.C. is to shake things up a bit in the ranks, and the proposal goes on to state, in regard to the new corporation, that "the terms and conditions of service of employees recruited after it has been established would be a matter for the Corporation; but it would be important to ensure that staff could transfer readily between the Corporation, industry, and other organizations both within and outside the Civil Service."

The idea of casting loose government laboratories and sending them into the market place would inevitably evoke a storm of political opposition in the United States, with charges of "give-away" and violation of the public interest. But in Britain, where the line between public and private is blurred in a semisocialized economy, the proposal has evoked relatively little notice. Nor, for that matter, has much interest, at least of a political sort, been shown in what has, in effect, been a test run for the B.R.D.C. concept —the conversion of the huge Harwell Research Establishment into an industrial consulting laboratory (*see* Technology Review *for October/November, pp. 10-11*). This has taken place over the past few years, and it has been on a basis that would easily ignite great populist tirades on the floor of the U.S. Congress. Harwell, which is something of a cross between the research segments of Oak Ridge and Argonne, has not only put itself at the disposal of industry but has done so on a basis designed to make the strong even stronger, regardless of the consequences for the others.

In line with government thinking that Britain's most pressing task is to sell more of its goods to the world, Harwell has deliberately sought out alliances with the most vigorous firms in the country, explicitly on the grounds that existing strength should be reinforced and that relatively scarce resources should not be devoted to prolonging the lives of laggards. Harwell officials themselves have proudly referred to their policy as one of "maximum unfairness," without arousing any cries of anguish from those who might contend that since the public originally paid to set up the place, its resources should be available to all who might benefit from them. At present, about 40 per cent of Harwell's 5,500 employees are engaged in work performed under contract for industrial firms, and the intention is to expand this role substantially in the coming years.

Ideology, politics, and the availability of commercial industrial consulting firms would make it difficult to transplant this pattern to the United States. But Britain is taking it in stride, and since the question of what to do with old national laboratories is a matter of concern to the governments of all industrialized nations, the British experiment deserves to be followed closely. In the United States, the proposals mainly center on directing them toward social problems, while simultaneously linking them closer to educational institutions. Nevertheless, while Americans might gag on the idea of throwing them into the commercial market place, the plan is not so outlandish that it does not merit sympathetic notice.



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Space options compete not only with each other but with the needs of the home planet. The aerospace industry upholds our balance of payments—but there are other kinds of leadership

Mortal, in the Bosom of Technology

It was a remarkable week, the week in mid-April that saw the explosion on Apollo 13 and the crew's safe return. This episode dominated men's thoughts in many nations. During preparations for the S.A.L.T. talks in Vienna, reported Chalmers Roberts of the *Washington Post,* there was a noticeable pause while men of both sides followed the news.

The explosion hung over the week like a shadow. Men die violently every day in large numbers in Vietnam, in Cambodia, in inadequate automobiles. No throngs stand before TV sets to monitor their slaughter, yet we stood transfixed awaiting the fate of three astronauts.

The astronauts' plight, it is possible, reminded us all that we are painfully mortal, even in the bosom of modern technology. "Like the best of the space age itself," one writer said, the Apollo accident "transcends national boundaries. For a moment, anyway, it brought mankind a little bit closer together."

The S.A.L.T. talks opened in Vienna during the week. They were expected to go on all spring and summer.

Almost no one in Washington denies the deep fear that men will sooner or later blow each other up unless the United States and Russia stop the arms escalation. Yet almost no one is optimistic about a meaningful agreement. The U.S. is to begin installing M.I.R.V.s (multiple independently-targeted reentry vehicles) on Minuteman-III I.C.B.M.s in June. The Soviets, it is said, are continuing to deploy the massive new SS-9 intercontinental killers.

At the same time, self-interest—if only through the acute need to spend less on arms—dictates a need for agreement on both sides. "There will be some kind of agreement, I think," said a State Department official. "Whether it will be one that means much is very hard to say. Certainly neither side trusts the other, and there is no real community of feeling shared by our people and the Russians." There is no emotional feeling of common danger, in other words, like the danger we all felt when we first knew about the A-bomb. After all these years, we remain strangers.

The Soviets were quick to offer naval help in midweek when it looked as though the Apollo astronauts might have to land in some unpatrolled ocean area. That moment of fellow-feeling quickly faded. What a shame that the two great nations had not already worked out some kind of peaceful space collaboration. Imagine the kinship that might have been created if American and Soviet spacemen had been side by side in Apollo 13.

The fate of those men out in space was still uncertain when the political talk about the space program began—friends of space-spending in Congress quickly saying, "We must have faith and vision. This accident should not be allowed to hamper the man-in-space program"; and foes saying, "This certainly means we must take a new look at the feasibility and costs of future manned space exploration."

Top N.A.S.A. officials hastened to report by the end of the week that the accident's cause—being apparently limited to one subsystem, a ruptured oxygen tank—should be quickly identifiable and curable. They expressed optimism that Apollo 14 would be ready to take off on schedule in October.

Even before the accident and the tense hours of Apollo 13's return, it was plain that a large segment of Congress would try to make further cuts, while others would seek to justify increases, in the fiscal 1971 space budget—to which President Nixon, as gung-ho for space as he may sound, and Johnny-on-the-spot with space medals, allotted only $3.3 billion, down $600 million from fiscal 1970 and the smallest N.A.S.A. figure since the early 1960s. "We expected a cut"—but not one this big, candidly admitted Dr. Wernher von Braun, N.A.S.A.'s new associate administrator for planning and handy star witness for Congressional appearances.

The $3.3 billion includes operational or planning money to:

1. Continue manned explorations of the moon through Apollo 19 in 1974.
2. Put up an Apollo orbital Skylab for three long visits (up to 56 days) in 1972-73.
3. Fly a set of earth-orbital satellites to test the idea of monitoring earth resources from out in space.
4. Get ready for a rich set of unmanned planetary missions throughout the '70s.
5. Put up a wide range of other scientific and application satellites, though not as many as in the '60s.
6. And finally *study,* but not yet start building, a bigger, permanent space station and a reusable space shuttle craft for cheaper space transportation.

St. Bernards of Space

Congressional scrutiny must bear hard on the space shuttle for two reasons.

One is that it is needed for space rescue capability. The Apollo 13 men could have been lost if their guidance or rockets had failed and they had bounced off the earth's atmosphere on reentry, skipping back into space. They would have been lost if their accident had occurred on their long voyage home, when they had no lunar module "lifeboat" to supply emergency oxygen and power.

An Apollo moon trip today costs at least $350 to $400 million. Flying a rescue rocket and crew from another launch pad might cost another $200 million. Neither space leaders nor astronauts nor members of Congress are about to seriously suggest spending that much on rescue. But a cheaper, reusable system to replace the costly one-time rocket—a craft to take off with rocket boosters, then glide back to earth for an aircraft-type landing—could do a rescue job.

Space officials and space scientists alike have recognized the need for such a system. It has been a key recommendation of the President's Space Task Group and of scientific advisory bodies to the space agency.

But the space administrators, like the Space Task Group, see it *as a tandem project* with the big late-1970s space station—the space station modules being designed to become eventual spaceships for manned voyages to planets like Mars.

The two concepts then, shuttle and station, are usually spoken of as a unit. To build the first shuttle craft and first 12-man space station unit by 1977, said Von

Braun, would take "on the order of a billion dollars more a year." Fiscal 1972 would have to see an added $300 million, with the extra billion or so starting in 1973.

What space scientists commonly fear is that the extra money will not be forthcoming, and the N.A.S.A. leadership will then dump scientific journeys to the planets and other unmanned projects in order to develop the transportation-cum-space-station system so as to get the ball rolling toward man-on-Mars. Until the very aftermath of the accident, admitted N.A.S.A. Administrator Thomas O. Paine Jr., space leaders considered dropping the last two lunar scientific expeditions—highly desired by lunar scientists—in favor of using their now scarce Saturn V rockets to put up still more Skylabs, thus filling the mid-70s with some kind of manned flight activity. This idea could easily be brought back to life if Congress looks dimly on other future manned space adventures.

Darwins of the Moon

Lunar scientists—scanning the samples and data from Apollo 11 and 12—now feel they are at least on the road toward solutions of the ancient lunar problems. They feel somewhat as Darwin must have felt after the first few landfalls of the long, 1831 to 1836 voyage of the *Beagle.* He was glimpsing new things; he was accumulating exciting facts; his mind was beginning to churn; the voyage, now started, must be completed.

"Losing this one landing is not a big perturbation," said Dr. Paul Gast after Apollo 13. He is the Lamont Observatory geochemist who recently agreed to spend a few years as chief of lunar and earth sciences at Houston's Manned Spacecraft Center. "What we hope most of all," he went on, "is that this accident does not put the whole lunar program in jeopardy. We feel it would be a great shame not to answer the really interesting scientific questions about the moon. Especially when we are so close."

Can Congress complete the lunar landings, finance science and earth applications in space and also give the nation future manned space capability, *without* an expensive commitment to a Great Space Station—at least until the earlier Skylabs prove themselves and more money is available?

The Space Science and Technology Panel of the President's Science Advisory Committee—chaired by Dr. Lewis Branscomb, director of the National Bureau of Standards—has offered just this middle course. It favored developing the shuttle without an immediate decision on the big station—and putting the manned shuttle to regular work as a cheaper, better system to install and repair space satellites than costly rocket shooting. This shuttle could then also be a rescue craft. Or the ship to take a crew into orbit around the moon—for further landings, if desired, or to descend to a moon base, or to direct robot explorations of the moon's rugged features.

Cleaners of the Earth

Sen. Edmund S. Muskie, Democratic sponsor of environmental clean-up, said at the close of Apollo 13's week that Mr. Nixon's $3.3 billion for space—compared with a mere $1.4 billion for housing, for example—was a "budget of unbalanced priorities." Sen. Gaylord Nelson, the Democratic environmentalist who suggested the April 22 Earth Day, said the environmental money must come from the military and space budgets.

"But how can we clean up the environment when Mr. Agnew tells us we must go to Mars?" said a questioner to Nelson on the Saturday after the Apollo accident.

"If they would send Mr. Agnew," Nelson answered, "the trip might be worth it."

But Mr. Agnew and other man-on-Mars proponents represent a serious and sincerely held point of view. N.A.S.A. Administrator Paine recently told an industry group that: "Very few people realize that the balance of payments that the aerospace industry generates is substantially larger than the entire U.S. favorable balance of payments. We not only within this industry pay for ourselves; we carry a good deal of the rest of U.S. industry on our backs.

"The other great earner in foreign exchange is the computer industry. These two industries pay the highest wages, provide more jobs and at the same time earn the foreign exchange. If this nation ever loses the technological lead that makes this possible, if we don't retain this five-year, ten-year out-in-front position that we've traditionally enjoyed, the entire way of life in this country will change very radically."

Space stations and manned space expeditions, however, are not the only possible contributors to technological leadership. Congress—as it weighs the Apollo accident—might do well to consider some other basic questions:

Would American technology gain more from developing manned or automatic space technology? Dr. Philip Abelson, editor of *Science,* argues for the latter.

Can American technology flourish unless there is a turn-around soon in support of all basic science and training?

Can the attack on the environment succeed without a large new program of research, development and specialized training? How much must it cost? And where should it stand in relation to space for priority in national spending?

As Science Editor of the Washington Post, *Victor Cohn directs and is a principal participant in that newspaper's coverage of scientific affairs in the nation's capitol. He contributes regularly in this space to* Technology Review.

"The rapid expansion in communications which can be expected during the 1970's throws up at least three classes of problems. . . . Inefficiency, crowding, or deliberate exclusiveness must not be allowed to accentuate today's disparities in access to information"

Seeing Each Other More, Enjoying It Less?

The information explosion, which can be expected to get louder and louder, underlines as well as anything the mixture of hope and fear which inevitably accompanies living in a technological world.

We need communication devices to live, and we need more of them to live better. But the whole process is like rushing down an ever wider and mightier river. One question never goes away: Will we rule the devices we made, or will they rule us?

The rapid expansion in communications which can be expected during the 1970's throws up at least three classes of problems—those of intensity, of conservation or competition, and of access.

The problems of intensity are the most worrisome, because they involve psychological factors which are not easy to predict.

The ever greater speed with which the so-called communications revolution is happening makes it certain that the peoples of the world are going to know a lot more about each other ten years from now.

It is less clear whether they will like what they see and hear—on television screens, over the telephone line, and on jet airliner trips.

Will there be more tolerance of cultural differences or less? Will there be more hope that technology can banish ancient slaveries, or new hopelessness about problems presented with such dramatic intensity and immediacy that they overwhelm the mind?

Communications satellites and television sets put events and personalities squarely in front of audiences of scores or even hundreds of millions, able to share anger or joy or horror. Sometimes this can happen instantaneously, as at a walk on the surface of the moon or the funeral of a man like Martin Luther King, Jr.

More often, the sharing occurs just a few hours after a cameraman defied the rhinoceros-like nature of television journalism and succeeded in obtaining pictures which will be stamped forever on viewers' memories—and strongly influence policy.

This happened when evening news programs in this country showed the recapture of the U.S. embassy compound in Saigon after a brief invasion by terrorists during the Tet offensive in January, 1968; showed a citizen of Prague kicking the treads of a Soviet tank after the invasion of August, 1968; and, a week later, focussed with brilliance on the clash between police and young demonstrators outside the Conrad Hilton Hotel in Chicago during the Democratic Convention.

The young demonstrators could chant that the whole world was watching and know they were telling the truth. This was not true in the same way 100 years ago, after an event like Lincoln's Gettysburg Address in November, 1863. To be sure, his words could be read in the next day's northern newspapers, but the techniques of photography were so crude that the cameraman could not succeed in obtaining a still picture during the short time Lincoln was speaking.

The impact of the immediate television pictures is immense—but by no means one-sided. It is likely that views on many issues are more intensely polarized by such pictures, which may well stiffen the back of an official who wants to resist a change in policy.

The Two Sides of Television

By showing pictures of the life of prosperous people (particularly through advertising) and of the misery of the poor (as in film clips of children starving in Biafra), television pictures doubtless will steadily create more and more widespread impatience with the inevitably slow, partly rational, partly irrational, partly cruel, partly benign process of raising people's standards of living.

The continuous reinforcement of impatience which television will bring throughout the 1970's can have only one result: intensified pressure for yet more technological development (with all its implied threats for the environment) to give people as close an approach as possible to the living standards of western countries.

Such pressure will eat away at the power of classes who resist it, whether they be the right-wing rulers of Spain or the village money-lenders of India.

But it will also increase the danger of violent, revolutionary upheavals (with all the danger of bringing to power a new class more efficiently rapacious and oppressive than those who ruled before). This is just as likely a result of the instant dramatization of television as any liberalization of social structures.

With the rapid multiplication of channels of communication, and the increasing intensity of utilization, electronic conservation becomes an urgent problem.

"Sharing" and "Re-Using" Satellite Channels

Experts in the communications satellite field look forward before the end of the decade to occupying all the easily available positions in geosynchronous orbit above the equator and all the information-carrying capacity of the frequencies between 4,000 and 6,000 megacycles now.

This point was made forcefully at the 1970 meeting of the Institute of Electrical and Electronics Engineers (I.E.E.E.) in New York by F.J.D. Taylor, long an employee of the British General Post Office and now with Communications Satellite Corp. (Comsat).

The demands will become so intense, Taylor said, that communications engineers will be forced to husband the circuits available in a communications satellite in many ways.

Not only will they have to move to higher frequencies; they will also have to "re-use" the frequency by discriminating between signals by polarization, send signals on multiple narrow beams from the satellites, and construct highly directive antennas on the ground.

It will also be necessary, Taylor said, to share every circuit by the so-called demand assignment system, refusing to tie up any circuit exclusively to link

two specific points on the ground. Instead, each circuit would be surrendered to the "pool" when it was not in use.

Taylor predicted that communications satellites will increasingly be used for such things as transmitting business letters by facsimile (to cut down on the slow delivery of air mail), telegraph messages between people of different languages and office hours, direct distance dialing among advanced countries and direct communications between computers.

So far, the only equipment for this is owned by the International Communications Satellite Consortium of which Comsat is the manager. Intelsat has rapidly proceeded with four generations of satellites, providing a rapidly growing number of circuits.

The Intelsat I satellite (Early Bird), launched in 1965, provided roughly 240 telephone circuits, and so did the Intelsat II series put up in 1966-67. The Intelsat III series, launched in 1968-70, provided 1,200.

The first of the Intelsat IV satellites is to go aloft next year; it will provide 6,000 circuits. This satellite will also be the first to carry directional antennas. Poised above the Atlantic, Intelsat IV's pair of antennas will focus beams at eastern North America and western Europe.

Many other developments lie ahead, however. Canada already has designed a synchronous-orbit satellite, to be launched in 1972, to provide television to its northwest and telephone service to its Arctic northeast and supplement its present transcontinental microwave system. Including ground receivers, the Canadian system is expected to cost about $80 million.

In an experiment aimed at even more directionality and power, the U.S. has designed its Applications Technology Satellites F and G. The first of these, equipped with a 30-foot antenna, is to be stationed south of India in 1973, according to an agreement signed last September, to broadcast Indian educational programs to small village antennas in 5,000 locations.

The Coming Age of Data-Relays

This is merely the beginning. Comsat and the Bell System both are developing satellites with much more capacity than Intelsat IV, although Taylor did tell the I.E.E.E. he doubted that such spacecraft would ever carry more than 25,000 circuits because of the catastrophic consequences to a total system of losing a large fraction of its capacity at one time.

The 1970's are full of projects for weather and other environmental monitoring satellites, which are expected to demand wider and wider bandwidths, and also—probably—data-relay satellites to allow continuous recording of large amounts of data outside the range of ground stations without the need for onboard tape recorders which often have proved to be the least reliable component of space observatories.

A further need for data-relay satellites is foreseen in the late 1970's, when the U.S. space agency, N.A.S.A., expects to put into orbit a space station carrying six or more men for periods of up to a year, serviced by a re-usable two-stage chemical "shuttle," and linked to a lunar orbit base by a nuclear rocket-powered "tug."

It is expected that the space station would be in an orbit inclined about 55° to the equator (a much higher inclination than the 33° path followed by Mercury, Gemini, and Apollo astronauts in earth orbit). If it were to be possible to communicate by television with the ground at any time, a data-relay satellite network would be needed.

The development of the shuttle, without which the space station would not have much meaning, also is expected to have a major impact on communications satellites of the 1980's. The reason is obvious: the existence of a highly maneuverable shuttle for low orbits gives promise of others which could be used to place satellites in synchronous orbits and retrieve those which fail.

Flexibility—if Accessibility

Within the United States, where much of communications technology is being developed and where its utilization is most profound, more and more conflicts are building up about who should carry certain types of signals and by what route. Among the unresolved questions are:

◇ Should specialized companies be permitted to compete with the national telephone monopolies by setting up their own long-range microwave links for communications between computers?

◇ Should domestic television broadcasting surrender many of the unused ultra-high-frequency (UHF) channels to permit extension of such local services as police, fire, and ambulance emergency calls, and phones in automobiles?

◇ Should cable television be permitted to expand into all major cities, to improve the quality of signals received, to save on increasingly scarce frequencies for broadcasting through the atmosphere, and to open up the home television set for such roles as computer terminal or display device for newspaper articles?

◇ Should the U.S. emulate Canada and develop a domestic communications satellite system for such purposes as providing a cheaper interconnection service for commercial and educational television, for communications in a remote area like Alaska, or for supplementing present signal paths?

Inherent in all these questions about conservation and competition are the questions of access. All the plans now being developed point toward fantastic flexibility and economy for users of communications—if conservatism and greed can be fought off, and the potential resources conserved from a wasteful pre-emption.

The possibility of wide freedom of choice through communications is reinforced by the news that C.B.S. Laboratories is pressing ahead with its development of electronic video recording (EVR) of black-and-white and color signals on inexpensive film that can be played on a cassette tape recorder that feeds into the home television set.

If C.B.S. can continue to drive down the price of the EVR cassettes and home players (presently $795), the development opens the whole repertoire of recorded television programs, movies and educational films to home play-back on demand.

The television reporter of the *New York Times,* Jack Gould, has pointed out that the existence of such equipment at a popular price could render irrelevant the current debates about cable television or a domestic satellite system and free owners of television sets from the dominance of those who control television programming today.

Such a happy possibility is not certain. There will be much resistance. It will be important for engineers of the 1970's to see to it that telephones and television sets—and computer terminals—be used to provide expanding personal choices and opportunities. Inefficiency, crowding, or deliberate exclusiveness must not be allowed to accentuate today's disparities in access to information.

Victor K. McElheny, Science Editor of the Boston Globe, *writes regularly for this department of* Technology Review.

Aldous Huxley once promised a new body of literature incorporating the "hypotheses of science into harmonious, moving, and persuasive art." Today's theater may be its forerunner.

When Science Takes Center Stage

Are the following sketches, would you say, drawn true-to-life or are they merely scenarios of imaginative stage plays?

◇ A young, brilliant biologist renounces a promising career in molecular genetics soon after participating in a breakthrough discovery. His ostensible reason: A concern for the well-being of humanity. He feels that inevitably scientific knowledge is perverted to evil ends by the men who control science, namely, the government and large corporations.

◇ During a security hearing that burrows into his soul, another scientist, this time a physicist, is compelled to account for his motivations covering a professional lifetime. The reason: To determine the loyalty of the scientist, who had exhibited moral scruples about building an H-bomb after having unflinchingly persevered in the creation of its older brother, the A-bomb.

◇ In an act of ethical fortitude, a third scientist, also a physicist of great brilliance, systematically burns his research papers, which have immense significance for the destiny of mankind. The young man's explanation: A fear that his discoveries will also be applied to evil ends.

Here is the background of the tales: The first is based on a news report appearing in *Science* (February 13, 1970). The last sketch represents pure imagination; it is the plot of a new play by Larry Cohen running at the Bouwerie Lane Theater in New York City, entitled *The Nature of the Crime.*

The middle scenario is a hybrid form, being neither all fact nor pure fiction. It is the story line of *In the Matter of J. Robert Oppenheimer,* a play based on the 3,000-page record of the proceedings instituted against the renowned atomic scientist (*see* Technology Review *for February, p. 75*) The author, Heinar Kippardt, calls his work a "documentary drama"—it lays bare "the core and significance" of an historical event but frees that event from "adventitious contingencies and irrelevant accessories."

Truth Stranger Than Fiction?

The three stories demonstrate how in our times the milieu of science is being embraced by serious writers of fiction. Without any fanfare, despite the lip service given to the "two-culture" gulf and the need to bridge it, there is gradually emerging a body of drama that places the scientist in the glare of the spotlight on center stage. By virtue of his omniscience that shapes the course of history, the scientist, in lieu of the kings and queens of Shakespeare's day, has become the Promethean figure, inspiring the symbolic works of novelist and playwright. Slowly but surely the scientific world is becoming a subject for literary exploration and interpretation, a treasure trove of themes, plots, and characters.

The theater-goer attending a play drawn from the history of science frequently finds it difficult to identify where the artifacts of the theater leave off and the facts of life pick up. Conversely, news accounts of scientific personalities, at times, can barely be distinguished from what otherwise might be the imaginative output of a playwright's pen.

The flesh-and-blood biologist referred to in the first of the three sketches, for example, is James Shapiro who, at the time of his defection from science, was actually a research fellow in bacteriology and immunology at the Harvard Medical School. Experts in his field considered him one of the most promising molecular geneticist in the nation. Today, however, Dr. Shapiro is a political activist deeply involved in campaigns to arouse the sense of social responsibility of scientists.

Purging of the Soul

Certainly, the young scientist may someday serve as a prototype for a Thespian character. Indeed, the same concept symbolizied by Dr. Shapiro's defection—the rejection of scientific knowledge for moral reasons—is espoused in *The Nature of the Crime.* Unshackled by the constraints of real life, however, this work of fiction is able to extrapolate the concept to its ultimate—albeit fanciful—conclusion. The protagonist in the play, Daniel Aronoff, purposely "blows" his brain with LSD to thwart forever his releasing of dangerous knowledge to governmental authorities. In his concern for humanity, the genius becomes a mental vegetable.

A similar sacrifice of self is made in *The Physicists,* a drama by Fredrich Dürrenmatt. The play had a brief run on Broadway about five years ago. In it, the archetypal scientist, Johann Wilhelm Möbius, feigns madness—he pretends to have conversations with King Solomon—to avoid having to divulge his terrible research findings. On behalf of mankind, Möbius succumbs willingly to incarceration in a mental asylum, and he has been there for fifteen years when the play commences. Möbius explains his actions "Our knowledge has become a frightening burden. Our researches are perilous, our discoveries are lethal. . . . We have to take back our knowledge, and I have taken it back."

It is revealing that the playwright invests his scientific heroes with a proclivity for Christ-like self-sacrifice on behalf of humanity. But the dramatist does this not necessarily out of sympathy with the scientist's lot; rather, it is an act of contrition for the scientist who has opened Pandora's box, a necessary purging of the soul. An extreme catharsis becomes the only way for the sinner to relieve his inner torment.

But what is the nature of this sin that causes such intense suffering? Translating the question to real life, Why did the atomic scientists experience such guilt feelings?

The origin of the guilt is two-fold. On the one hand, the penitent scientist had harbored all along an awareness that his work would be applied to evil ends. Yet he persists relentlessly at the task while subconsciously aware of the inevitable outcome, although he may rationalize away or otherwise dispel his concern by playing psychological tricks on himself. But, above all, he cannot assimilate the one attitude that could assure peace of mind—a blase indifference, the kind expressed by Herbert Georg Beutler in *The Physicists:* "I know there's a lot of talk nowadays about physicists' moral responsibilities. . . . This is nonsense. We have far-reaching pioneering work to do and that's all that should concern us."

What then drives this humanistic scientist onward? For personal fulfillment, he simply must take up the adventure of the

How can a scientist assure that his research results—which may hold immense potential for benefit to mankind—will not be used for evil ends? In The Nature of the Crime, *Daniel Aronoff, played by Tony Lo Bianco (below) concludes that he cannot—and so systematically burns his papers. (Photo: Martha Swope)*

scientific quest and technical challenge. But, there is as well an even more insidious motive: the chance for fame and immortality that can accompany the bringing forth of new discoveries.

When the realization sets in, after the initial flush of success, that these all-too-human but self-serving and self-aggrandizing motivations really underlie his allegedly noble quest for knowledge, the conscience-stricken scientist suffers profound remorse. "We have been doing the work of the Devil," exclaims Oppenheimer of the physicists' involvement with the military.

Nuclear Monsters and Execution Chambers

Such charged interpretations can readily be ascribed to personalities involved in the creation of the atomic bomb, which is one reason why this highly publicized and fascinating period of history appeals to fiction writers. (Another, of course, is that this era marked a turning point in the history of mankind.) Here we have a cluster of earnest humanitarian scientists—deeply concerned about justice and morality—ironically caught up in the fathering of weapons of unbelievable devastation . . . through their own initiative. What more exquisite poignancy could a dramatist seek!

The 33-year-old author of *The Nature of the Crime* is especially brutal, particularly on those who supported work on the H-bomb even though they morally opposed its development. In an unforgiving and merciless script, Cohen compares the technical challenge that went into the building of these nuclear monsters with the organizational skill and technological challenge required for the secretive and systematic execution of 6 million European Jews. (The comparison is cynically drawn through the reflections of a dead German soldier.) Both projects, the play suggests, were equally immoral—and, most important, equally thrilling for those doing the work.

While the extreme viewpoint of such plays is bound to incur controversy, fiction of this genre does stimulate introspection. It also offers may insights into attitudes rocking the scientific community today. This is not to say that scientists are forgoing their researches out of fear that laboratory results will be misused; James Shapiro is still a rare character. Nor do they routinely offer up their lives in penitent self-sacrifice, as the protagonists in the drama do.

Such Christ-like behavior is beyond the capability of scientists . . . as it is of most humans—even playwrights. Instead, radicalism, militancy, and rebellion against the establishment that controls the science it funds becomes the real-world manifestation of the same moral sensibilities. It is the compromise between the extremes of complete indifference and total abnegation, but it is a terribly impassioned middle ground, precisely because of the profound reasons revealed in the theater.

None of these dramas may ever join the ranks of the great classics. Each is faulted in some way. *The Nature of the Crime* has excessive and even silly Freudian overtones that detract from its seriousness and provocativeness. *The Physicists* lacks dramatic power, and *In the Matter of J. Robert Oppenheimer,* which is bounded in by the documentary form, is blandly written.

Perhaps some day a Tennessee Williams or an Arthur Miller, if not a William Shakespeare, will tackle such powerful themes with their formidable talent. But until they do, any of these plays still offers a rewarding evening of theater. Furthermore, they may even be viewed as transitional works that will lead to a new body of literature incorporating the "hypotheses of science into harmonious, moving, and persuasive art," as Aldous Huxley once phophesied.

Stanley Klein, who studied industrial management at M.I.T. (S.B. 1958), is now Eastern Editor of Machine Design *magazine; he was formerly Editor of* Engineer, *magazine of the Engineers' Joint Council.*

Many Gods and Many Voices

La Machine Infernale

Music by Computers
Heinz Von Foerster, James W. Beachamp, editors
New York, John Wiley & Sons, Inc.,
139 pp., $14.95

Reviewed by
Stephen W. Smoliar
Department of Mathematics, M.I.T.

This book is a collection of papers and sample recordings presented at the 1966 Fall Joint Computer Conference in a session entitled "Computers in Music" organized by Heinz Von Foerster. Von Foerster contributes an introductory essay, "Sounds and Music," which has absolutely nothing to do with computers and only slightly more to do with music. It purports to be a biological explanation of why we hear certain sounds as music and others as noise—although composers from Bach to Cage have made it quite evident that the distinction between music and noise is much more sociological than biological in nature.

Each paper can be taken quite independently of the others. Reading them, one quickly realizes how unaware the individual contributors were of each other. Indeed, one gets the impression that they had no desire to pay attention to one another, and that the session was more a cavalcade of individual medicine shows than an occasion for a constructive exchange of ideas.

If this is not enough to discourage the curious, openminded reader, consider the vast propensity of the authors for making definitive statements. Having partaken of Von Foerster's pretensions, one may then proceed to M. David Freedman's cut and dried definition of the computer music laboratory which centers on his own, personal feelings about music, never considering such pragmatic matters as expense.

James W. Beauchamp reports on a system to synthesize musical tones. He writes, "Only by the examination and study of a large amount of data can we expect to describe the sound output of a musical instrument over its complete dynamic and pitch ranges and take into account the variations due to style, context, and chance." All these ideal goals are then left by the wayside for the rest of the paper.

There remains the question of *motivation* for a system such as Beauchamp's: "We may now be at the threshold of the discovery of mathematical descriptions for *beautiful tones,* as they are commonly termed in conventional music." Once again, we have Von Foerster's obsession—however futile such ambitions may be in the face of music history.

Arthur Roberts' paper is modestly titled, "Some New Developments in Computer-Generated Music." He expresses concern that electronic music sounds too "electronic"—electronic instruments almost always possess a periodicity in their outputs which the more "human" instruments can never attain. It is the imperfections of the "human" instruments which, Roberts feels, make them "interesting." Such imperfections of sound quality are generally lumped under the all-embracing category of "timbre."

On purely scientific grounds, Roberts has posed a viable problem (although the recorded examples Roberts provides come nowhere near any form of solution), but its consequent music value is dubious. In a later paper J. K. Randall—a composer at Princeton—lashes out violently at Roberts' motives and ideas.

Scientists such as Arthur Roberts, who uphold theories of music which are both adamantly definitive and artistically specious, pose one kind of threat to the future of contemporary music. Roberts' output to date has been relatively small; Lejaren Hiller, who approaches composition the way Roberts approaches synthesis, poses a more serious danger.

In terms of both overall input and public relations, Lejaren Hiller is the most prolific contributor to the realm of computer music. His two major creations, *Illiac Suite for String Quartet* and *Computer Cantata,* have even been commercially recorded by Heliodor; and according to his paper here he is still grinding out works of the same nature. Hiller gives the impression of being one who wants desperately to be a composer but who clings to mathematics to save him from the drudgery of the musician's discipline. He approaches music in the most cold-blooded manner, his most prominent thesis being that music is analogous to a thermodynamic system and that the key to the compositional theory of music lies in Shannon's information theory.

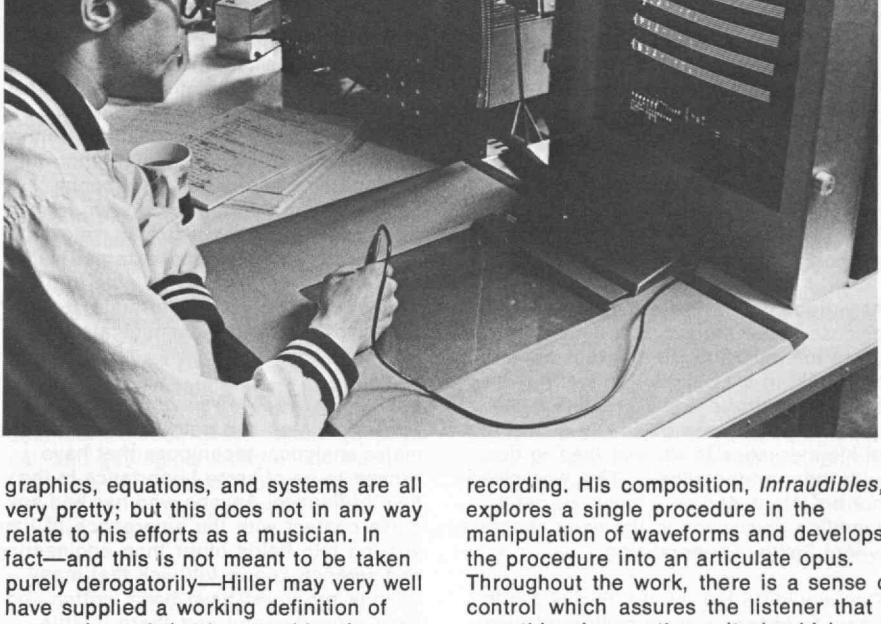
If Hiller wishes to be a composer, then like all other composers he should be judged on the basis of *what* he has done rather than *how* he has done it. On this score, his work may cause even the most notorious iconoclasts of our time to hesitate. The composer Ezra Sims, whose current work is primarily in tape collage, observed once that music always has to articulate something. Thus, he is justified in splicing together another's materials if he fashions a statement of his own. One may further apply this rule of thumb to Cage's 4 minutes and 33 seconds of silence which articulates the silent moment.

Hiller's work boils down to the design of an array of mathematical systems, each of which, at the very last stage, has its output converted into musical terms. He has nothing to say; he leaves that part to the computer, i.e., to his systems. They in turn have nothing to say. Their structure is purely stochastic; and they are thus as capable of articulation as any elementary thermodynamic system.

Of course, there are instances where, in the absence of any articulation by the composer, the burden is assumed by the performer, as in Charles Laughton's dramatic readings of the Manhattan telephone directory. From almost any musical standpoint, the *Illiac Suite* is lacking as writing. The Heliodor recording is an improvement, due to the human element introduced by the performers. *Computer Cantata* is less interesting because the performers are bound by the score beyond the point of expression—at least this is the impression one gets from the recording.

Hiller's current work, as presented at the Fall Joint Computer Conference, is the same in theory and in results. His

M.I.T.'s Walter D. Bilofsky uses a PDP-9 computer adapted for sound synthesis and analysis. He is shown using a program, of his own design, for the construction of a musical score, which the computer plays using sounds designed with the help of a second, sound-specification, program. At right is the visual output of this program, which enables the composer to edit the characteristics of his chosen sound. (Photos: Don Estes)



graphics, equations, and systems are all very pretty; but this does not in any way relate to his efforts as a musician. In fact—and this is not meant to be taken purely derogatorily—Hiller may very well have supplied a working definition of *nonmusic,* and *that* is something for us to think about.

If the work of Hiller is the most discouraging contribution to the session, that of M. V. Mathews and L. Rosler is the most encouraging. Their system is the only one which attempts to satisfy the desire of the musician for immediate interaction with his instrument, the computer. Almost no work has been done in this area; this is unfortunate, for if a composer loses the element of spontaneity, he may easily degenerate to a designer of systems, like Lejaren Hiller.

The Mathews–Rosler facility is a beautiful application of computer graphics, whereby the musician can write out a score (although not in conventional notation) and then hear it played back. He can alter the score, and store the finished product. The examples they present here have little musical value, but they do demonstrate the potential of the system. Since they do not pretend to be serious music, they perform their task well.

Herbert Brün's contribution provides the volume with the most inane piece of writing and the most musically interesting recording. His composition, *Infraudibles,* explores a single procedure in the manipulation of waveforms and develops the procedure into an articulate opus. Throughout the work, there is a sense of control which assures the listener that everything is exactly as it should be; and the statements are so sure and clear that one is quite willing to accept Brün's musical vocabulary on its own terms.

J. K. Randall is quite fed up with the music-synthesis ambitions of computer scientists. His argument is that rather than apply psychoacoustics to the synthesis of familiar sounds, one should investigate the new parameters made available by the electronic media as a basis for a new theory of electronic music, which is necessarily disjoint from other music theories.

Randall thus stands as the only sensible musician in the volume. Admittedly his literary style is dreadful—overly florid, disdainful, and occasionally too-cute. His *Lyric Variations,* the accompanying recording, do not really put his money where his mouth is. But Randall will readily admit that, as a musician, he is quite swamped by the available facilities; he seems to take his work seriously and shows more potential as a musician than the other contributors.

If one accepts Randall's argument, then one may ignore the subsequent papers

buried and which threatens to bring the current trends of music to a grinding halt. Perhaps Randall's unpleasant literary style was inevitable. Perhaps all a musician can do by way of "dialogue" with technology is virulent sarcasm. It may be the only way to attract attention.

Towards the Strategy-Machine

Putting M.I.S. to Work
Norman L. Enger
American Management Association, Inc.
255 pp., $10.50

Computers, Systems, and Profits
Paul T. Smith
American Management Association, Inc.
200 pp., $10.50

Quantitative Analysis of Financial Decisions
James C. T. Mao
The Macmillan Company 625 pp., $10.95

Reviewed by
Richard B. Maffei
Associate Dean, Boston College
School of Management

Computerized information systems are assuming three distinct roles: systems for operational control, systems for management control, and systems for strategic planning. Here we have a group of recent publications which, between them, illuminate these three kinds of management information systems (a phrase which has now dwindled to *M.I.S.).*

Studies by respectable consulting groups such as McKinsey, Booz-Allen, John Diebold, and Arthur D. Little during the past decade have added substance to the notion that the design of information systems develops first from simple applications programs, through modularized subsystems, to more integrated collections of subsystems (at the present time, very loosely coupled), then to fully integrated systems, and finally to systems which are of use to top managers for planning and evaluation purposes.

Enger's book tends to illustrate the first stage. Although, it seems to me, written from the computer supplier's point of view, it does give valuable aid and assistance to managers and executives who are seriously interested in obtaining a comprehensive view of some of the more technical aspects of the business of managing the information system environment. Enger does not, for example, deal with the problems of the design of applications programs, or talk much about the strengths and limitations of different languages. He does, however, do a first-rate job on those considerations of "system design" which matter to a technical designer of hardware and permanent software (now called firmware). There are good check lists for managers at the end of almost every chapter, a glossary, and suggestions for further reading, but the table of contents and the index are poor.

Smith's is an angry though useful book. In substance it is essentially a major (though hypothetical) case study of a concern called Circle Manufacturing Company, CIMCO, followed by an attempt at a more general treatment. The book as a whole gives the impression that it is indeed difficult to design complex management control systems when the effort is riddled with even more complex human relationships.

The book tends to be chatty while dealing with obviously serious problems that never quite surface in the written material. It is obvious that many of the author's personal experiences have gone into the "hypothetical" illustrations—what he has written is no novel. There *is* a critical methodological issue: how to design a system that is flexible enough to accommodate changes of policy and procedure made necessary by new conditions. There is a critical problem area: the impact of computer technology upon human work and value patterns. It *is* genuinely difficult to know when to put one's carefully articulated developmental and operations policy into action. It is difficult to create a team and the right conditions for systems design work. There is, finally, a problem in getting the support of top management.

At various points the author does indeed discuss these serious problems—sometimes intermittently, in different parts of the book. In my opinion it might have been better to begin by organizing the questions that were obviously at the root of his messages to us, and then to deal with them systematically. This was clearly not his intent, and as a result we get a rambling discussion in the early chapters, where Smith is generalizing.

One would be led, by the title of Smith's book, to expect a more comprehensive treatment of, certainly, *systems* and *profits.* The title is really not descriptive of the contents. There is very little in the way of detailed system description of flowcharting; system integration is only touched upon; the major substantive company illustration and the few minor ones are not sufficiently broad-based to give the reader a feel for the truly immense number of developmental possibilities available to the various kinds of industrial, business, service, and governmental institutions. Smith simply does not deal with the performance evaluation and profit measurement problems. Few, however, will dispute his suggestion that businesses can no longer operate without their computers.

Mao's book lies in another dimension. One does not even find the words "computer" or "data processing" listed in the excellent index. How then does such a book qualify to be included here as representative of stage three, the development of planning and evaluation aids for top managers?

Among the folklore of the M.I.S. community is the belief, accepted by a large segment, that top managers will begin to receive reports from their companies' computerized information systems when large-scale-integrated processors are finally conceived and built. Many deduce that this day will be some time coming, because this technology has a good long way to go. Running counter to this view is the faith that improvements in database management will make it possible to do unheard-of things. This is possibly true, though experts might argue that the sort of data-management schemes that will be needed for generating answers to a vice-president's questions likewise require a long incubation period.

A small but growing group of analysts are now starting to think in terms of designing information systems specifically for top managers, rather than waiting for the lower-level systems to evolve upwards. After all, for this less ambitious task the technologies are available. Not only is time sharing with us, but there is every evidence that small, inexpensive computers with communications capabilities may be extremely useful too. Furthermore, top managers need data of a more processed and "richer" quality than the usual transaction-oriented company data base. An information system for top managers needs concentrated, relevant information (internal and external to the company), and needs to be able to organize it into acceptable formats; it needs to be able to communicate graphically and to analyse.

In *Quantitative Analysis of Financial Decisions,* Mao has gathered together the major analytical techniques that have proved to be of some importance in the field of finance. Anyone who has had any close contact with the emergence of time sharing into fields other than engineering and science knows full well that many finance programs have been written and have proved useful and there is little question that developments in the financial field will continue. But Mao does not note the rapid development here at all—it does not appear to have been his intention to discuss or even mention the fact.

However, the book is a first-rate effort in its own right, weaving together problems and technique in a very skillful way. In textbook materials, the dominance of operations research *method* now appears to be giving way to a more substantial treatment of the problem areas, in order to illustrate significant method.

Methods range from linear to non-linear to integer programming; from the mathematics of finance to those of engineering economy; from calculus to stochastic processes; from queuing theory to simulation methods. This book provides a compendium of methods and substantive problems in the area of finance that will hopefully be followed by other authors in other functional areas such as marketing, personnel, manufacturing, and planning.

A methodology of strategic planning is now starting to appear. There is a strong case for the view that top managers can acquire their computerized information

system by developing their own systems, *not* necessarily linked to, or even a part of, the systems needed for operational or management control.

These three books show, first, that system design efforts must be cautiously and deliberately planned and implemented; second, that analytical methods can offer a great deal to the company which knows how to use its intellectual capital; and third, that human relationships and organizational design provide the key to effective growth potential.

Something Rich and Strange

Hot Brines and Recent Heavy Metal Deposits in the Red Sea
Egon T. Degens and David A. Ross, Eds.
New York, Springer Verlag, 600 pp., $32.00

Reviewed by
Fred A. Frey
Assistant Professor of Geochemistry, M.I.T.

The first indications of deep hot brine pools in the Red Sea were recorded by the Swedish ship *Albatross* in 1948. During the period 1963-65 oceanographic vessels from the United States, England, and Germany confirmed the initial results, and the importance of the hot brine areas was recognized. In 1966 the Woods Hole Oceanographic Institution (W.H.O.I.) ship R. V. *Chain* conducted a detailed six-week geochemical, geophysical, and geological study of the Red Sea. The *Chain* expedition generated most of the papers published in this impressive book.

In the light of current geologic hypotheses, the Red Sea is an extremely interesting area. It appears to occupy part of a large crack in the continental crust of Africa and Arabia. An axial trough runs along it, and the area seems to be our most recent example of continental drift and sea-floor spreading. Some excellent Gemini satellite photographs—one of which is used for a jacket illustration—have provided dramatic visual confirmation that the African continent was formerly continuous with the Arabian shield. In many respects, the Red Sea area is a small-scale example of the work of geological mechanisms which appear to have been important worldwide.

The finding of hot brines with associated metal deposits is thus quite exciting, not only because the Red Sea is apparently unique in this respect, but also because what we are observing may be an ore deposit in formation. There is a further point of interest: the possibility that metal-rich deposits are to be found in the rift valleys of other oceanic ridges.

Three deep brine areas have been found, totaling about 70 sq. km. In the principal one, the Atlantis II deep, the bottom layer (below 2,040 m.) has a temperature of 56°C. and a salt content of 257 parts per thousand. This 56°C. water is separated by a sharp interface, only 5 m. thick, from a 30-m.-thick layer of 44°C. water whose salt content is 135 parts per thousand. The 44°C. layer is similarly separated from normal Red Sea deep water (22°C., salt content 41 parts per thousand) by another sharp interface. Thus, the brines exist as well-mixed layers separated by sharp interfaces. J. S. Turner, of Cambridge University, reports that such layers are characteristic of liquids which are "stabilized" with salt but are rendered unstable by heating from below.

An excellent article by H. Craig of the Scripps Institute of Oceanography synthesizes the chemical and isotopic data for the brines into an excellent model for the origin, age, and history of the brine water. His data demonstrate quite convincingly that the 56°C. brines originated in the southern part of the Red Sea near the Strait of Bab el Mandeb. The model starts with normal Red Sea water flowing northward (approximately 800 km.) beneath the Red Sea floor. During this northward flow, the water encountered some of the extensive evaporite deposits which are known to be present beneath the Red Sea. By interacting with the evaporite salt deposits, the water became a brine, with a metallic content similar to the brines associated with the salt domes of Louisiana.

A search for bacterial organisms in the brines proved generally negative, but the study of the shells of organisms which lived in near-surface water and entered the brine sediments after death has been quite useful. Measurements of the relative abundances of foraminifera species, and isotopic studies on shells, have provided evidence for past changes in environmental conditions. These appear to relate to the opening and closing of the land link between the Red Sea and the Indian Ocean.

The section of the book dealing with the sediments below the brine deeps includes two color plates of sectioned sediment cores. These plates illustrate beautifully the dramatic variations in color at different sediment depths caused by mineralogical changes. An excellent paper dealing with the brine sediments—their mineralogy, chemistry, and genesis—is presented by J. Bischoff of the University of Southern California (then at W.H.O.I.). He discusses in detail the seven primary facies: detritus; iron montmorillonite; goethite-amorphous; sulfide; manganosiderite; anhydrite; and manganite. It is clear that these solids were precipitated from the overlying brine. Much of the iron deposition appears to originate from interaction at the interface between the primary brine and normal Red Sea deep water. The mechanism by which the sulfides were precipitated is not clear—the base metals (for example, zinc and copper) originate in the brine, but the source of the sulfide anion is not known. Bischoff discusses the alternative mechanisms which could account for the sulfide deposition.

One of the most exciting features of the metal-rich sediments is that an understanding of these Red Sea deposits might aid in the discovery and understanding of ore deposits in continental areas. If they were on land, it is likely that the Red Sea brine deposits would be economically exploited. The estimated value of the zinc, copper, lead, silver, and gold exceeds 2.5 billion dollars. But to industry the in situ gross value alone does not decide whether a deposit represents a profitable ore body. Papers presented by researchers from mining companies indicate that pumping the poorly consolidated sediments to the surface appears feasible, but that a major problem would be the processing required to obtain the pure metals. At present it appears that the costs of metal extraction might well exceed the value of the final product.

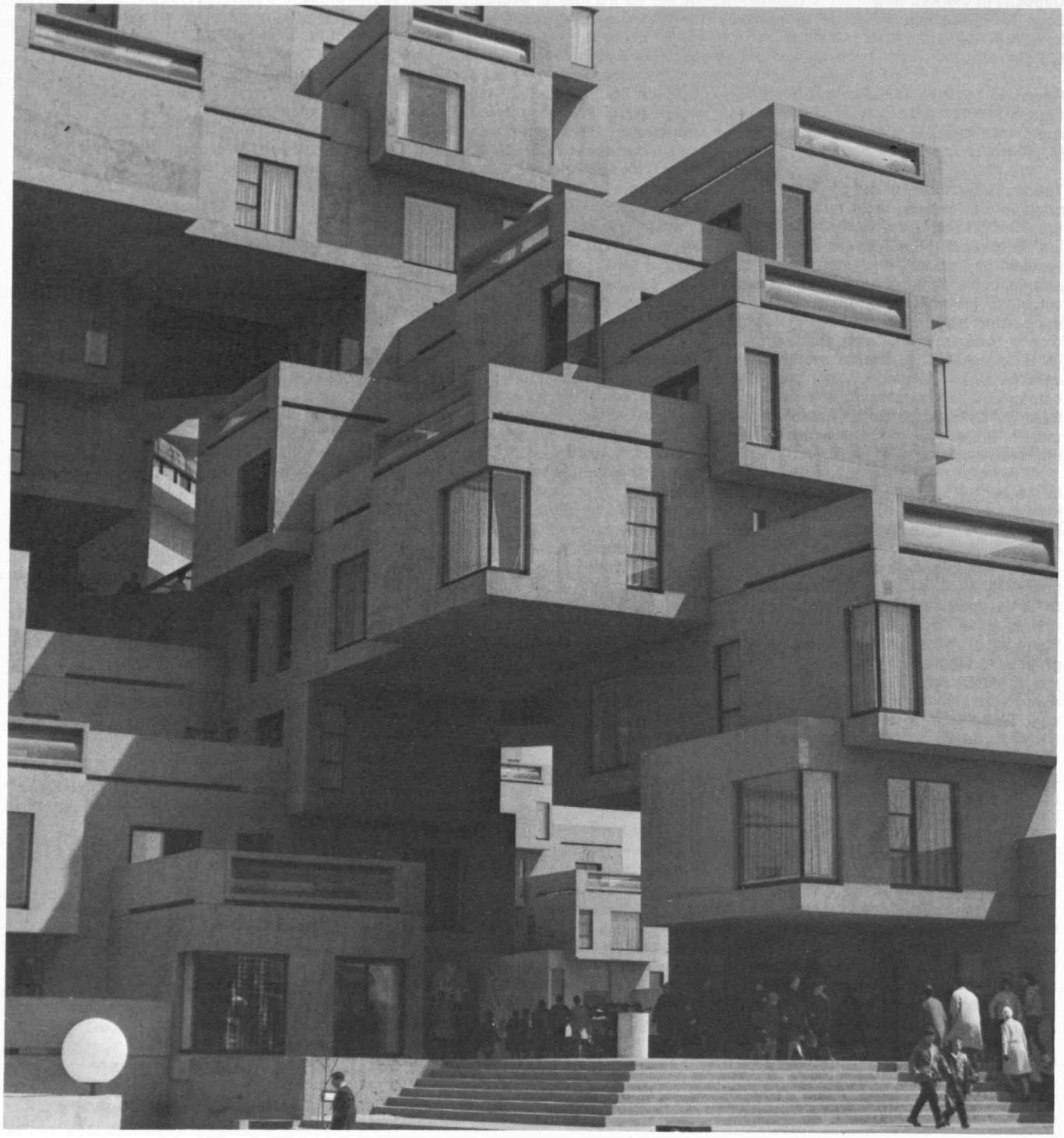
Nevertheless, the book ends with a paper by a lawyer, W. Griffin, who discusses the question of legal ownership of the Red Sea deposits. His conclusion is that they belong to Sudan, which is the nearest coastal state. In a summary article, a group of researchers from W.H.O.I. comment that " . . . there is a distinct possibility that lawyers will profit more from the Red Sea deposits than will scientists or the metal industry."

Oceanography is an excellent example of a modern scientific front which requires inputs from several fundamental fields, such as chemistry, physics, and biology, and the contents of this book—more than 50 papers—illustrate this fact. The authors include researchers from universities, oceanographic institutions, and mining companies in seven different countries.

The high price will keep *Hot Brines and Recent Heavy Metal Deposits in the Red Sea* out of most personal collections, but it will be well read in geological and oceanographic libraries. The editors and publishers are to be congratulated for their promptness in making conclusions from a fall 1966 research cruise available in book form by September, 1969. The quality of the papers is rather variable, due in part to the pressure of deadlines. This disadvantage is outweighed by the usefulness of having all the data discussed in one source so soon.

In this era of voluminous literature it is invaluable to be able to consult with confidence a single book on such a major topic as that of the Red Sea brines and heavy metal deposits. Of course, all is not solved, and W.H.O.I. is sending an expedition back to the Red Sea later this year.

Architect Moshe Safdie's Habitat, a uniquely gathered assembly of concrete cubes erected in compliment to the 1967 World's Fair in Montreal, represents at once the prospect—and the frustration—of mass-produced building. "We must beware," writes the author, referring to mass production in the building industry, "of adopting a method that has worked elsewhere without understanding the foundation of its success." (Photo: M.I.T. Rotch Library)



Most previous technologies have grown up along with the industries to support them; but in building "the industry already exists, viscous with established practice"

J. Karl Justin
Director, Projects Administration
Max O. Urbahn Associates, Inc.

Can We Rebuild an Industry?

One commonly expressed view about the high and increasing cost of building construction in the U.S. is that if only we would apply the mass production techniques which reduced the cost of the automobile so drastically, the problem would be resolved—a $50,000 house (analogous to a $50,000 hand-wrought auto) would be brought within reach of everyone for $600 down and $50 a month for three years. Or, at any rate, "assembly-line" techniques would bring huge cost reductions.

In fact, techniques ranging from total prefabrication of entire building modules (mobile homes, Habitat, etc.) to integrated combinations of components (heating-lighting-ventilation, roofing-structure-ceilings, roof-deck-power-supply-ventilation, etc.) have so far met with only limited success, in terms of the sought-after economic benefits. Probably the most successful have been the mobile homes, but at an obvious price in quality of life.

Specific undertakings aimed at developing new techniques and effecting major savings (such as the School Construction Systems Development project in California) have had less than a moderate impact on building costs. The scale of such efforts has admittedly enabled some new and better individual products to be created. Some manufacturers who participated have stopped marketing their developments, while others are selling them at a premium independently of the systems with which they were originally integrated.

Major city and federal efforts in mass-produced housing have likewise produced only questionable returns. In Detroit, where 40 or 50 companies were expected to compete for contracts for factory fabrication of homes, three companies actually entered the competition. Some of the designing was, to say the least, peculiar; a house with a second floor furnace room that could be reached only via an outside ladder, and one with but a single door, opening directly into the dining room, with the entryway closet ten feet away around the corner.

This is not to say that mass production techniques, in some form, may not be part of an answer to the question of how to reduce costs. But we must beware of adopting a method that has worked elsewhere without understanding the foundation of its success. If we want to emulate the successful techniques of more progressive industries, we should, more fundamentally, adopt their philosophies—goal-orientation, cost-effectiveness, and systems analysis—and use them with a full understanding of the *context* of building-industry operations. And we should remain open-minded: for example, it may be that the real benefits to be gained from improved methods are in areas other than costs.

So let us talk not just about building systems, but about building-*industry* systems. And let us begin with a brief survey of the environment of the building industry: the diversity of its products, the status of fields wholly or partially outside the building industry which affect it, and some of the implications, and validity, of the current desires of the customers.

The Problem of Variety

It is not just a matter of building homes. As well as housing (low and high density) the industry must provide schools (elementary, secondary, and higher, with facilities for residence, administration, learning, storage, athletics, and fine arts); hospitals (special and general purpose, and research); stores and shops; offices; auditoriums; factories (plus storage and research facilities); and a miscellany of structures that fall into none of these categories.

Within any one use-category there are wide differences in methods of operation—differences relating to staff and service, traffic flow, personnel interrelationships, special equipment systems and the distribution of supplies—these choices being dependent on such considerations as budgets, integration with existing facilities, proclivities of administrators, and recent developments in the user's field. The result is a wide variation in types of facilities which, on the surface, would seem to have very similar needs.

Of course, there may still be enough volume in many of these subgroups to justify some form of standardization. But we see that the problem is quite a bit more involved than to be solvable by the development of a few factory-fabricated building units. If building systems are developed they must be far more numerous in their types and variations than one imagines on cursory inspection.

Either there must be systems for each distinct building category, or there must be subsystems basic enough to be interchangeable between categories. The degree of interchangeability is inversely related to the scale of the

prefabricated units. In other words, if we have a building system which consists of four quarters of a school, to be put together on the site to form a whole, we are not likely to be able to use it for a hospital. If our school-building system consists of sections of walls, sections of roof, and other similar major components, we are more likely to be able to use it in building other types of structures, since the sections don't automatically form classrooms. At the other end of the scale, one can build almost anything with nails, lumber, bricks, and mortar.

Even if user requirements were virtually identical from building to building, there would still be substantial divergences from site to site: variations (often arbitrary) among local building codes are the most obvious, but also important are variations in climate, in geology, in the availability and economics of utilities (gas, electricity, water, sanitary and storm sewers), in the supply of particular materials and the skills they require, and in accessibility.

These site-to-site variations suggest that there is a limit to how much of a building can be standardized. And a great economy in one part of the job may be only a small economy in the whole. It may be that even the most effective "breakthrough" would yield a final "rental" or "cost of ownership" saving of no more than 5 per cent, and that (except for housing) this gain would not really offset the loss of value associated with a more standardized (or, less "customized") product.

It has also been argued that the cost of operating most buildings is so high compared to the cost of the physical structure that it is worthwhile putting up an expensive, individually designed building if it improves operational efficiency. (Amortized over its life, with all costs fairly accounted, physical plant is usually only a few per cent of total annual operating cost—it is highest perhaps in housing.) But the effect of building design on operating costs is generally impossible to evaluate—which is perhaps more an indictment of cost accounting and management than of the building industry.

A limitation on the use of prefabricated parts is that their costs tend to be high if they have to be shipped over any distance. So there may have to be many local plants. There is also the question of whether the market for a building type or a subsystem will be geographically dense enough to call for "factories" of an economic size at economic spacings. The capital investment of setting up prefabrication facilities is, of course, substantial (and generally overlooked by the assembly-line romantic) and there is always the risk that a sleeping giant at the site will awaken. Many a new investment has foundered on the assumption that the competition would stand still.

The Boundary Conditions

Cost savings, however, are not the only criterion. Savings in time, greater accuracy, better workmanship, better maintenance, closer integration of work of different rates, simplified buying, interchangeability, demountability, and possibilities for controlling the obsolescence of the product—these are the real benefits promised by better techniques; and well worth going after. But it is clear that only very limited real progress can be made in construction techniques alone without reaching into other fields. It might be that, technically, the building industry is already nearly optimized, and that the only chance of substantial progress is to change the boundary conditions—operational, financial, legal, and political.

In the forefront of these is the bête noir of building: trade unions. A great deal more is involved here than simple recalcitrance toward labor-saving techniques and desire to avoid more demanding standards of craftsmanship.

It has been said that the true cost of building is the cost of labor plus material, plus the cost of labor's control over material. In the simplest kind of "innovation" dispute, a union local in one of the building trades refuses to install a labor-saving item. An example is the now famous "Philadelphia Door" case where the union mechanics refused to install 3,000 prehung doors called for by the architect's plans. An effort was made in the courts to compel the union to make the installation. When the matter was carried to the Supreme Court, it ruled in favor of the union.

As a result legislation has been proposed to prohibit unions from boycotting prefabrication. More recently, the National Labor Relations Board has ruled that such action against prefabricated materials constitutes a secondary boycott and hence is illegal. How the N.L.R.B. and the Supreme Court decisions are reconcilable is not clear, but these rulings in any case do not come completely to grips with the problem.

For one thing, they concern only prefabrication away from the site. There are many new methods that could profitably be introduced right at the job location. For another, there is a whole range of informal, unwritten tactics enabling unions to avoid the legal problems that would be created by a direct refusal to supply manpower.

So—written laws, court precedents, and labor-management contract provisions notwithstanding—the union local usually has the power of life or death over the business of a building contractor with whom it has an agreement. Today construction work is for the most part subcontracted by the general contractor to various spe-

cialty firms, each of which depends completely on a limited number of trades. A subcontractor seriously at odds with the union of his trade could find a miscellany of previously overlooked restrictions in his union contract, with an exceptional number of disputes, falling productivity of his work crews, unlooked-for delays, and so on. The result would be that he fails to meet his commitments, that his bids on new work must be too high, and that, undercapitalized as he probably is, he will soon be forced out of business. Beyond this, more than one overly loyal superintendent or employee has inadvertently fallen down an empty elevator shaft or had his skull fractured by a moving two-by-ten. The contractor therefore sees to it that his relationships with the unions are no less cordial than those of his competitors, and that any controversial innovations are fought industry-wide if at all.

In view of all this, while there is a continuing effort on the part of the contractors to improve productivity, for the most part it takes the form of only minor changes from standard practice. There are enough hurdles for the contractor without embarking on any greater efforts to change the industry.

Should he or an innovative architect really wish to do so—with the cooperation of a courageous manufacturer and owner—he is confronted with the most crucial deterrent of all. He knows the written and the unwritten rules, and he knows that sometimes change will be allowed to occur if properly structured. But he cannot be certain of a specific change until he has gone through all the effort and investment of actually making it. He can get tentative nods before, but a union veto after the fact can bring the whole project to nothing. And there is no telling whether an innovation will be acceptable: the attitude of the union delegates is sphinx-like.

In short, anything more than a minor innovation requires one hell of a risk and possibly one hell of a fight, with costly aftereffects in the contractor's regular business. A motivation for such risk-taking might be generated by sharp competition, but the market is simply too profitable for that just now. And on the other hand, a shortage of work has an effect on the unions the reverse of what might be expected. Instead of increasing productivity to bring prices down and stimulate business, the tendency is to decrease productivity, featherbed, etc.

The Divisions of Labor

Complicating all this further is the division of building labor into many trades. (Ceiling contractors in New York, for example, are obliged to employ no less than nine separate trades to accomplish their no longer exotic work.) Any far-reaching changes in techniques—such as shop fabrication by union men working at field rates in the area of the local—will probably require reaching an agreement with the union locals of several trades.

The existence of these many separate divisions of trades also leads to jurisdictional disputes between them, with the contractor and owner caught in between. As an attempt to avert stoppages from this source, the National Joint Board for Settlement of Jurisdictional Disputes, has run into killing fire from contractor associations and unions alike, not all of whom subscribed to it to start with. Its procedures are so slow that the job is finished before the Board reaches a decision (which will usually apply to the disputed job alone). Hence, any union having to avail itself of the Board is essentially out of luck, and the union will prefer to bring all other possible pressures against the contractor making the work assignment.

The main significance of this aspect of the problem is that the idea of cross-utilization of building trades, without overemployment or featherbedding, is crucial to the creative development of techniques which transcend conventional demarcation lines.

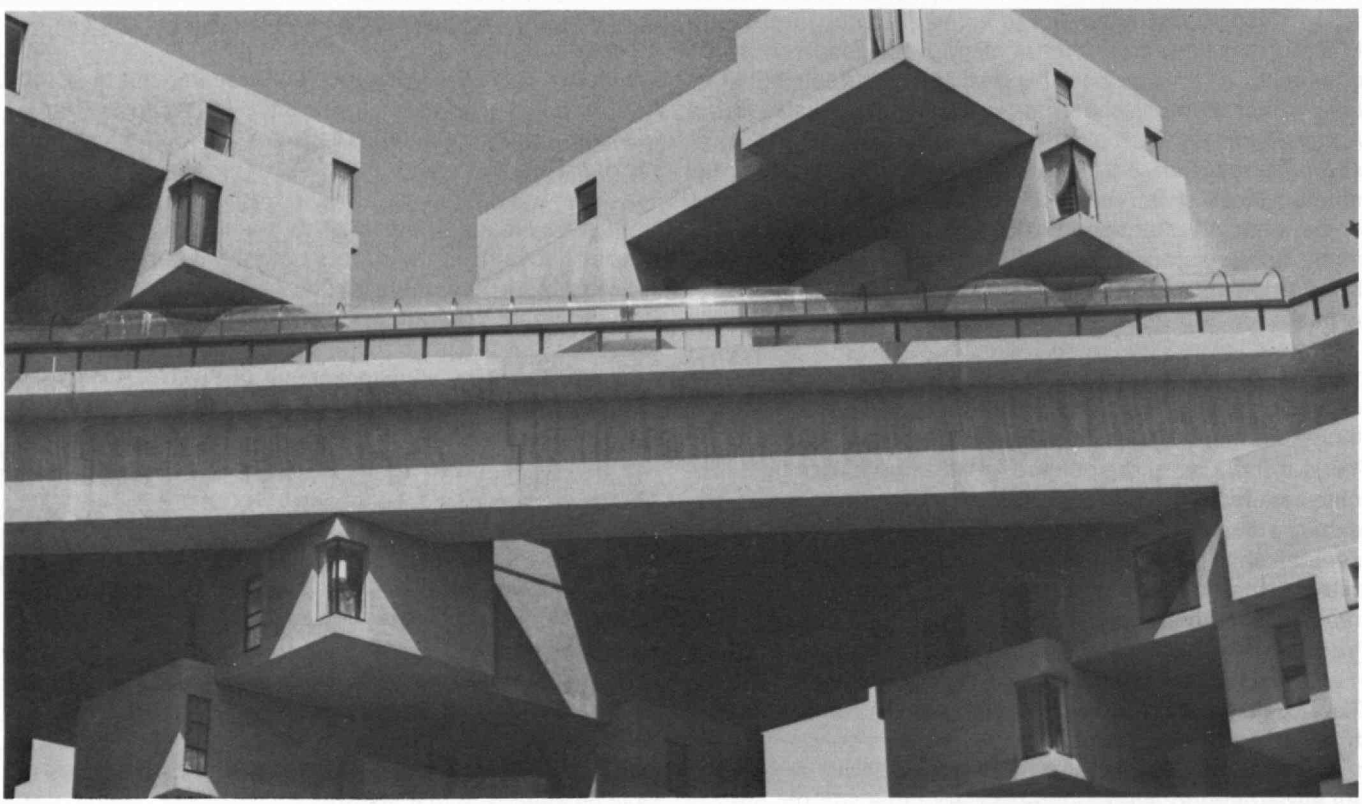
One further impediment is the regional diversity of union practices. Since usually only one key man is allowed to be imported from one local to another, there can be no centrally trained, roving crews. Once a new practice is accepted by a local of a given trade, there is a better chance of its being accepted in other areas, but it is still only an improved probability. Even when national union leadership sees the benefit of certain changes over the long run, it is rarely able to advance their cause. The leadership may be enlightened, but the rank and file membership wants short-range results.

It must be clear by now that the problems which the innovator faces have their roots not merely in the building industry but in the entire structure of American labor law and its interpretation. He who attacks the sanctity of labor in the building industry must in some measure take on the entire labor movement in the U.S. Considering the voting strength of organized labor, this is not a hopeful prospect.

On the other hand, to shift work from one trade or union to another is more likely of success, and hence the factory-fabrication approach has certain appeal. At present factory labor is less costly and more pliable. One can only conjecture, however, as to how long any such discrepancy would last.

One essential ingredient of industrialization is the use of relatively unskilled labor rather than skilled craftsmen. But it is an error to conclude that unskilled labor can only be employed in a factory.

The building industry faces creative technologists with a new kind of problem. "Most previous technological advances have been developed along with the new industries needed to exploit them. . . . The building problem cuts deep because we must alter existing methods and institutions, must face up to and correct past errors. We are forced to replace an irrational structure with a rational one." (Photos: Habitat (Expo '67) from M.I.T. Rotch Library)



In a recent announcement from Detroit, it was indicated that a producer of housing units was completely factory-fabricating houses for shipment to the site, and installing them at a total cost 25 per cent less than the cost of houses completely built on site in the conventional manner. Later on in the announcement it was revealed that his factory labor, recruited from among unskilled Negroes, is costing him $2.50 per hour. (There was also a federal employee training subsidy.) Now, how long will he be able to hire factory labor for $2.50 per hour? And, just as an arithmetical exercise, how much cheaper would a *site*-fabricated house be with $2.50 labor and the same subsidy?

There is a clue in this, though, which may work for reducing costs of low-income housing—the idea of training the currently unskilled poor in the building trades, so that labor supply and demand in this area would bring labor costs more nearly into line.

In a somewhat different vein there is what Secretary of Housing and Urban Development Romney calls "sweat equity," whereby low-income housing buyers would be obliged to accomplish part of the finishing work themselves.

The Reluctant Manufacturer

The idea develops very early in one's business experience that labor and risk are almost synonymous; that the safest item to merchandise is one involving more material and less labor. The larger, more conservative interests are happy to leave the construction field to those more willing to live with higher, short-term risk.

In fact, manufacturers generally have concentrated on rationalizing the raw-material end of their operations, have been decreasingly involved with the actual field situation, and have grown less able to integrate their product developments thoroughly. Most of the manufacturers' information on new product needs comes from their contractor customers via sales representatives. Under straightforward, logical circumstances, there would be no great need for the manufacturer's direct involvement in the use of his products. As it is, his assistance would be welcome; but he is too far removed from the action to be able to contribute much.

The labor situation and remoteness from the field are not the only limits on innovation by manufacturers. They are further restricted by the conventional "compartments" into which building components are grouped. Not only are subcontractors and mechanics grouped in this manner, but building codes, bidding procedures, and a thousand other daily practices are predicted on these divisions.

Certainly, in some undertakings, components have been combined. Roof-decking systems have been integrated with horizontal roof structural members; exterior walls with vertical structural supports; lighting with heating and ceilings. But even these broader divisions require large-volume installations in order to succeed, because members of all building trades involved must participate in the work, in a fixed ratio agreed upon by management and unions.

A further restriction here is that most public agencies are required by law to take separate bids at least on heating, plumbing, electrical, and general contract work. And finally, each building code is administered by a specialist local inspector who is prone to interpret even a uniform national code in his own individual manner, certainly viewing with suspicion any unconventional multitrade component. The design professions, too, are divided into separate specialties, although on a professional level communications are generally a little more open.

Not only is understanding and information inhibited this way, but also the manufacturers' ability to market products requiring special training or experience to install. Although in times past some manufacturers installed their own products (and some still do) a common practice was to distribute them through franchised installers, each of whom had an exclusive territorial right and was obliged to sell an interesting amount of the product or lose the franchise. (Since sales are related to product quality and proper installation, one of the best ways to sell the item is to see that it is properly installed. The franchisee also has a considerable interest in improving techniques or helping the manufacturer develop desirable new products.)

Legal Barriers

However, in recent years interpretations of antitrust law have placed the exclusive territorial franchise in the "restraint of trade" category. As a result, not only is a major source of new product ideas being cut off, but only new products whose success is not too dependent on installation are created. The case where manufacturers have or acquire their own capability as part of their firm is also under a legal cloud. How these problems will relate to the "consortia" being established as part of the Department of Housing and Urban Development's "Operation Breakthrough" remains to be seen.

Another legal area having an effect on innovation is that of patents and their protection. There are several factors mitigating the value of patents. First, the basic life of a patent is only 17 years. In the construction industry, a new idea has to go through many slow stages before it emerges as a visible installation; by which time there may be less than 10 years of active life remaining to it. Of these, the last 3 years of any really successful building patent are riddled with violations (this being the length of time it takes to get an infringement dispute settled). And in any case (in the language of the legal fraternity) "the courts do not look kindly on patents." Rulings tend to be relatively liberal about what constitutes an interference and conservative about awarding damages.

Besides, the patent system is conceived in the first place to protect devices, whereas much of modern progress is in the area of ideas and system concepts—in software, rather than in hardware. The usual recourse —to cloak the idea or principle in a device and try to write as broad a patent as possible—is necessarily precarious.

Even success, rare as it is, has its penalties. There is at

least one case in the building industry where a firm's patent was so successful that it created a virtual monopoly, by being so cheap as to make all competition incapable of competing. The company was forced to license others to manufacture the product.

Economic Forces

We can now perhaps understand why investment in really radical changes is not apt to be overexuberant. And we have still not considered the financial forces that influence the choice between innovation and conservatism. A brief inspection will show that some of these influences work one way, some the other.

First, the cost of real estate and of assembling the proper parcels on which it is feasible to build buildings efficiently for the intended use is influenced not only by the density of population and the degree to which property is in demand, but perhaps even more by the zoning regulations pertaining to the property. In this sense, to some degree, property values are made by fiat.

Another important financial area is the cost that can be attributed to the nonusability of the land during the construction period. Real estate taxes continue and short-term construction financing is expensive. The sooner the new building is completed and in use, the better. It is in this area that any techniques for acceleration, whether organizational or technical, produce real financial benefit.

The cost of current purchase procedures for buildings is also a major factor. Organized purchasing for large groups of similar buildings has already shown its strength in terms of improved product, if not in cost reduction.

I have already mentioned another major cost—that of operating and maintaining the finished building. In this area also, improved techniques can make a major contribution by optimizing component life and serviceability.

Perhaps the most obvious single influence—since buildings are seldom paid for in ready cash—is the prime interest rate. Over a 20-year period the cost of aggregate interest payments is one of the same order as that of the building itself. In this light, a 1 per cent drop in the interest rate can produce far greater savings than can realistically be expected from the most radical change in construction methods.

Finally, another obvious influence is that of real estate taxes and assessments. Taxes are not only a direct cost but also have an influence on the age at which a building can most profitably be resold, and hence on how durable its components should be. Repairs are operating expenses and therefore tax deductible and, in varying degrees, preferable to high initial outlay.

Among the significant secondary influences, probably the most important of all, and the most inexorable in its working, is the requirement for balanced development of neighborhoods and cities. Housing accommodates the population which is the fuel for economic development; industrial plants are both support facilities and suppliers of purchasing power. Without a certain proportionateness, housing will be less than desirable, industry will lack high-quality manpower, and the stores will go begging. Our dying downtown centers reflect a dislocation of this balance. The helter-skelter success of suburban sprawl reflects a different kind of dislocation. Owing much to huckstering and to a lack of desirable alternatives, this temporary prosperity by no means insures us against future deterioration into gigantic suburban slums.

In the foregoing observations the subject of law has come up repeatedly—labor, antitrust, patent, tax, and zoning laws, as well as building codes.

There are still other legal areas that affect building, such as legislation for historical preservation, conservation, and fine arts commission or "architectural committee" review—which are well-meaning in their intentions but are often illogical or mean in the application. In New York City for instance, the facade of a legally designated landmark must be preserved, but the remainder of the building may be demolished and replaced. And many a town can boast a review commission strongly influenced by local manufacturing interests or, worse, the unidentified inclination to increase property values by restricting newcomers. As a first glimmering of recognition of the significance of these constraints, a new Bar Association Special National Committee on Housing and Development Law has now been formed. Hopefully, similar attention to some of the other areas outlined above will also follow.

Those Who Dwell Therein

Tracing the relationships between building and various facets of the law—which in our democracy is naturally contingent on the active or tacit support of the electorate—eventually leads us to examine our politics, ethics, and aesthetics in the largest sense. It raises the question, can the situation in the end be better than the participants in it?

One noted architect has remarked that if profits are to be derived from poor and ugly buildings, they will be built. But it also seems true that expensive buildings are constructed in preference to cheap ones on similar grounds. Before we build millions of standardized housing units, we should ask what premium the poor would

in fact pay for custom housing? (How many of the poor have TV? Does the automobile owner in the low-income group drive the cheapest car on the market?)

The individual wants to make an input into his environment, and that includes his buildings. Will he welcome a single, universally imposed low-cost building breakthrough, however sagacious? In trying to provide for people, we must remember that they act as if there are greater goals to be sought than economy.

If we believe Veblen, we are barking up the wrong tree with *cheaper* building. The pecuniary canon of taste—conspicuous consumption—dies hard. The well-conceived and highly touted "new town" of Reston, Va., (financially rescued by Gulf Oil, in order to recoup a multimillion-dollar investment) had one major problem: its town houses—efficient, economical, well-designed town houses—were hard to sell. Did the buying public equate these with city row houses? In fact, will the public buy efficient, intelligent, balanced planning?

The market history of developments such as the telephone, television, the automobile, seems to follow a pattern: in the beginning the richest, who are the leaders of popular taste, pay for the expensive novelty; and society follows in imitation, generally getting a modified version. There may be a clue here. If affluence is, in fact, increasing at all levels and destined to continue in its growth as the think-tank seers predict, the key to the future may lie in making high-grade improvements in buildings, and letting the growth of purchasing power do the rest.

Suppose that rational optimization dictates the development of a disposable architecture—short-life "throw away" buildings; would the public still want brick fireplaces, and philanthropists continue to insist on colonnaded porticoes on public buildings? Suppose financial analysis dictates that the greatest housing economy comes from living high-rise in suburbia; will the public still want single-family housing on half-acre plots? Suppose the science of urban planning proves a need for flexible cities, segments of which can be demounted and updated to meet new conditions; will the public demand instead greater permanence?

In short, goal-orientation, cost-effectiveness, and the systems approach are techniques with their roots in rationality, which commend themselves to those disciplined in the application of reason. The rest of the world, and the strata with which the building industry must deal, are certainly willing to hail the results of technology and reason's output. But a very fundamental change is going to be needed before the bulk of the consuming public will actively participate in building-industry systems. Meanwhile, the taste of the buyer remains a massive unknown.

To sum up, there are an almost discouraging number of hurdles to be cleared if we are substantially to improve the utility of the building industry. It can be done, but we must seek the answers where they are apt to be found, not where the spotlight of public relations is brightest or the rhetoric most soothing.

Most disturbing of all, perhaps, is that we—as creative technologists—are faced with a new kind of problem. Most previous technological advances have been developed along with the new industries needed to exploit them. New developments were made by many small firms which grew—in a welter of activity in which successes were copied and failures learned from—into a large industry.

Here, the industry already exists, viscous with established practice and legal or quasi-legal restriction. The building problem cuts deep because we must alter existing methods and institutions, must face up to and painfully correct past errors. We are forced to replace an irrational structure with a rational one.

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The Apollo program may be man's severest test of the reliability of a complex system of systems. "The problem facing our nation," says the author, "is how to get high-performance reliable equipment in order to move forward." But a prediction of reliability remains a complex engineering question. (Photo: Apollo 8)

"... this paper could be interpreted as a scheme to nail the supplier to the wall, and in a sense it is. However, it is also meant to nail the purchaser to the same wall ..."

William G. Denhard
Associate Director, Draper Laboratory, M.I.T.

Reliability: How to Command Success

If a piece of equipment is there when you need it and it works—every time—it can fairly be called reliable. To measure reliability, you turn it on, and if it works, it's reliable.

To predict reliability is not so easy. You can turn one piece of equipment on a thousand times, or five thousand times, and analyze the result statistically. Alternatively, you can analyze the result of turning five thousand separate pieces of equipment on once, and repeat this operation one hundred times. Or run one item continuously for one year, or three years. Or run tens or hundreds of items that long.

The "bathtub curve" of failure (Figure 1), derived from such testing, helps to make sense of the way failure rates change with time, but it can be used for prediction only if the items you use for the critical application were made in the same production run as those you tested. And the test program must use standards of performance bearing some resemblance to what is required of the equipment in actual service.

But if only a few items are needed for a limited but critical application—too few for statistical analysis—how then do you determine reliability?

In the space program, the National Aeronautics and Space Administration has been able to afford to commit relatively large numbers of any given critical item to a test program, as well as to carry a significant lot of spares. One way of achieving reliability was to be at the right point on the bathtub curve at lift-off, as determined by a combination of discrete tests and statistical survey data.

Sometimes it is also possible to discover symptoms of failure in individual items by watching changes in operating characteristics, and to define failure in these terms. Associated with this type of definition is the practice of taking data to detect any failure symptoms (or conversely to assure the lack thereof) during the practical use of the item. This testing can be done during so-called maintenance periods, or it may be incorporated into instrumentation integral with the item, and be measured (or indicated) continuously. For any item, it is learned that a particular symptom precedes failure by at least "X" hours, so nonoccurrence of the symptom implies "at least X hours to go."

All in all, prediction of reliability implies *experience* with the item, or in some cases with its "family." To obtain enough experience, enough testing must be done. This N.A.S.A. did, and was willing to pay for, before using items in a critical application. In other government agencies, particularly the Department of Defense, thorough testing before purchase is not unheard of, but is certainly not usual. There are often good reasons for leaving the testing until after delivery: complexity, testing costs far exceeding the untested price, budgeting restrictions which afford little or no funds for testing by the manufacturer, and the experimental nature or uniqueness of the item. But for most items bought in quantity, testing at the source to establish, re-establish, and prove over and over that each item conforms to the norm, and that the norm is adequate for the application, would actually save great sums of money. For, if an item's normal performance is below what is needed in the field or if it frequently falls below the norm, it will require excessive maintenance, which adds to its real cost in many ways.

Two Sets of Books

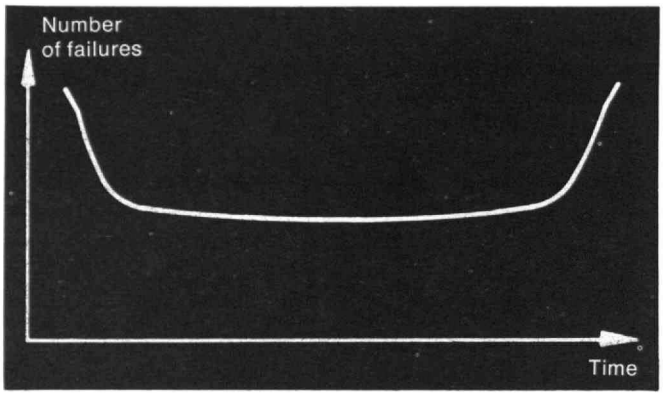
This apparently obvious expense often goes unnoticed by the purchasing office because the cost of acquisition and the cost of maintenance are kept in two separate sets of books. The agency personnel who have charge of developing the item generally bear no responsibility for its exhibiting an adequate service record and conforming to the norm of reliability. Nor are they available to lend their experience to the user or maintenance agency—far from it: they are more likely unidentifiable!

Although maintenance costs may be excessively high, the need to keep equipment operating gives maintenance a priority claim on budget money. Whatever is left over can be devoted to improving equipment. Improvements are thus secondary to maintenance, especially if they add to tooling or cause changes in parts or procedures—even though the unimproved equipment may be grossly inadequate.

To try to put right the shortcomings of such a system requires a titanic effort—transferring personnel, setting up a new type of task grouping, and fighting Congress, the Civil Service Commission, D.O.D., local empires, personal prejudice, and general apathy.

There is fortunately another path. Here we encounter

How do you predict reliability? One way is to learn this "bathtub curve of failure," which helps to make sense of the way failure rates change with time. There is an optimum minimum point on the failure curve, when the equipment is "de-bugged" but wear and fatigue have not yet begun to take their toll.



only the decision makers, possibly Congress. And we don't look backward, we only look forward. It is the path N.A.S.A. took: test before delivery and, if necessary, double-check after delivery. See that each item conforms to the norm, by knowing what the norm is and matching performance against it. Above all, see that the "norm" is what is really needed.

This approach will greatly increase initial cost—"acquisition cost"—because now, testing to insure adequate working life must be performed as a part of the delivery requirement. My thesis is that by this means money is saved, because the testing can force reliability into the design, resulting in longer life and thus greatly reducing future acquisition costs. Moreover, reduced maintenance costs will themselves more than cover the increased acquisition price. The result, in the end, is the long-sought "better item at a lower price." The vendor has been forced to upgrade the design of his product in order to make a deliverable item.

To summarize the cost philosophy that should be used, total cost includes acquisition cost, plus the cost of: checkout, usage, operational maintenance, and repair maintenance. Individuals with no financial training consider these factors in buying a car more carefully than do some of our government agencies in making multi-million-dollar procurements. In addition, the car buyer gets a better warranty. However, the buyer gets the warranty because the supplier knows his product from testing and has, through competitive incentive, forced necessary improvements into his design wherever needed. In ordinary life, the buyer thinks naturally in terms of what I call Reliable Performance Life and Cost per Use Hour—two key concepts which should be applied more often to federal purchases. I hope here to contribute toward an answer to the question: What is true cost-effectiveness?

A Gyro, for Example

The procurement of precision gyros will be used as an example to indicate the value of testing in terms of cost-effectiveness—meaning delivered cost plus use cost. These gyros are the type used in highly accurate inertial-navigation systems, military and civilian, and should not be confused with the crude gyros used, for example, in short-range air missiles, although the principles expounded here hold for all. (The acquisition cost of these would be on a lower scale than in my example).

First, is there, in a functional sense, more than one kind of gyro? If there is more than one, then the question of cost-effectiveness should be answered separately for each.

The functional aspects of a gyro are generally defined thus: A. *Purpose*—A gyro responds to angular rotation. It and its associated circuitry may be designed to measure rotation rate, change of rate, angle of rotation, or deviation from intended position. It may serve to sense unwanted rotations and, through gimbals and servos, stabilize a platform. B. *Basic Components*—1. *A gyro wheel,* which must spin rapidly to create an angular-momentum vector and which must keep spinning for the life of the gyro. 2. *Precession-axis bearings,* which must have low friction, to allow the gyro to precess in response to rotation (or, for a two-degree-of-freedom gyro, to allow the angular-momentum vector to stabilize itself). 3. *A pickoff or signal generator* (visual, electrical, or perhaps mechanical), which must not interfere with the gyro's movements. 4. *A caging or biasing "torquer."* Although not used in all gyros, in many applications this is needed for initial alignment, correction of gyro errors, and for external correction and/or modification of servo-system position. 5. *An overall structure,* which carries the gyro's internal components and physically adapts the assembly to the servo platform, autopilot, panel board, or whatever else it governs. C. *Significance to Mission*—Depending on the application and on the degree of redundancy, the gyro may well be totally critical to mission performance and to the safety of the vehicle and crew.

A single-degree-of-freedom floated integrating gyro, such as has been the technical foundation of most navigation systems, is shown schematically in Figure 2.

The most interesting point in all of this is that in describing a gyro in these general terms, no mention need be made of performance, reliability, life, or price. In a functional sense, there is only one kind of gyro, and Figure 2 is equally applicable to a $100 gyro or an instrument costing $10,000.

This means that specifications that reduce or limit performance, reliability, life, and price cannot do so by changing the gyro's functional purpose or basic components. In addition, the significance of the gyro to mission success may be reduced only by redundancy (using two or more gyros) or willingness to abort the

mission. Because a low-price gyro is describable, functionally, in the same terms as a high-price gyro, one could take the attitude: Why buy a high-price gyro if nothing is added? The point of this paper is that something should be added by the higher price: assurance of performance, reliability, and life. It's up to the terms of the contract to see that the added quality is there and can be proven by testing. It is also up to the terms of the contract to allow for the necessarily higher acquisition price, and not force necessary testing out of the contract by limiting funds.

We had better be clear on what we mean by failure—particularly since to increase testing so as purposely to fail deficient items, and thus prevent their delivery, is a primary goal of an adequate test program.

Failure of a gyro can take one or more of several forms, some catastrophic and some "relative." At the time of acceptance by the purchaser it is feasible to reject on the basis of either type of failure, if the contract is so written. When the gyro is required for service in an aircraft or other vehicle which critically depends on the gyro in a go/no-go manner, it is worth carefully reviewing the types of failures that have caused initial delivery rejects. A significant number of catastrophic failures (examples are open circuits, spin-bearing lockup, or precession-axis bearing failure) would indicate, in some applications, a higher risk than desirable.

Thus, the types of failures which occur may have significance and influence beyond mere percentages. Furthermore, they are indicative of strong and weak points of design and/or of the contractor's capability.

The acceptance of some N.A.S.A. items was conditional on no failure symptoms being apparent. This was on the basis of experience; it was known that in the absence of failure symptoms, useful life was at least "X" hours, since failure followed "X" hours or more after the symptom.

For other items, knowing the life history, one could place an individual item at its life-expectancy point on the bathtub curve.

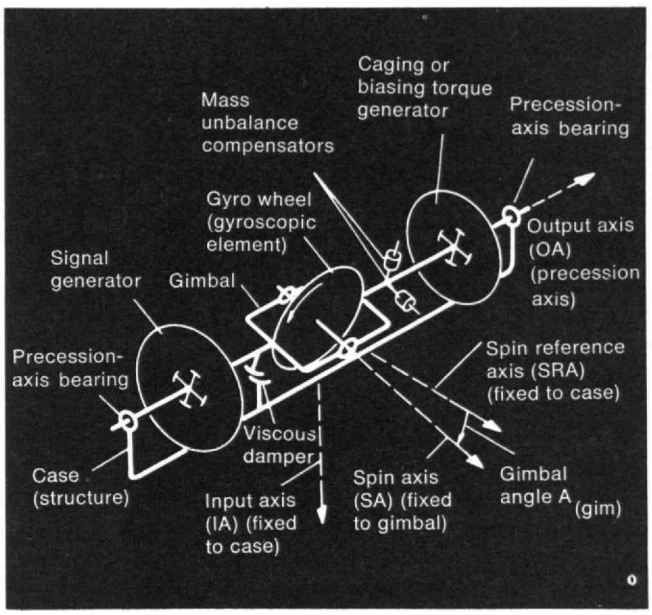
For precision gyros of the type we are considering, most failures are, or should be, performance failures rather than catastrophic. Adequate definitions of acceptable performance are required in each contract (if desired, stipulations can be added regarding the conditions allowing waivers).

"Time Between Failures" Can Mislead

It is not unusual to describe the worth of a gyro (or system or bearing) on the basis of mean time between failures (M.T.B.F.). This, however, can be misleading. During a time when the number of units in service is increasing rapidly, all of the gyros are adding to the sum total of operating hours. At this time, no gyro really has a significant number of operating hours behind it, and so failures are few. An M.T.B.F. figure obtained by averaging will be deceptively high.

An unrealistically high M.T.B.F. can also result from the practice of installing new gyros at times when vehicles are in the depot for other reasons. So those who take heart from a good M.T.B.F. number should investigate the conditions that created it, and either perpetuate these conditions or prepare for a later change in M.T.B.F.

No definition of a gyroscope—nor any description of its purpose or basic components, such as this illustration provides—speaks to its reliability or price. In a functional sense, there is only one kind of gyro; specifications that affect reliability or price are another parameter which cannot influence its basic role.



My own view is that absolute-life figures for individual gyros would be more useful than M.T.B.F. figures, in evaluating field performance and true costs per operating hour in the field.

When a gyro is purchased, the manufacturer does a certain amount of testing before delivery. This testing is intended to assure some level of performance and provide a basis for predicting a reliable lifetime. I consider that testing time should, in practice, represent from 5 to 15 per cent of the expected total operating life of the gyro. Furthermore, the lower in price the gyro, the higher the percentage of expected operating life that the test time should represent.

One vital point: Testing does not, of itself, affect the quality of an item. Properly done, it reveals what that quality is. A short, superficial test does little to accomplish this revelation of quality. Properly contracted for, the testing will ensure that the delivered item is up to the required norm.

It is axiomatic that to obtain better quality in the market one must be prepared to spend more money but may expect better value. The table below reveals the simple reason. Test time is normally a fixed portion of the total expected operating life—in the case of gyros, 10 per cent. Thus a 500-hour machine is tested for 50 hours, and if its price is $2,000 the cost per use hour is $2,000/500 = $4.50. As expected operating life (and hence test time) increases, the cost per use hour goes down. The relationship is shown graphically on the opposite page.

A test program designed to reveal quality and purposely made equal to 10 or 15 per cent of required Reliable Performance Life will, if the results are made a criterion for purchase, serve to force the required quality into the item. (To be successful, the contract requirements should also include some full life and specialized performance testing to validate the norms established.)

As we have seen, adequate testing is not only valuable in determining the quality of the gyro, but also, because of its indirect influence on the gyro's operating life, can be economically profitable to the purchaser.

This latter statement remains true even though increased testing adds to the acquisition price. For suppose that 500 gyros are ordered—this number being a reasonable quantity for a production run—and that the price is set accordingly. Assume also that the model has been built before, so that all tooling and drawings exist; and no development effort is needed. The purchaser has one variable to work with: the amount of testing called for, both in the request for quotation and in the ultimate purchase order.

A certain level of performance should not be contracted for without also contracting for testing adequate to prove that performance. The same is true of Reliable Performance Life. A testing period which represents a defined percentage of the total expected operating life must be contracted for, and fully applied, in addition to some defined program of extended-period tests.

Value and Cost per Use Hour

So, let us further assume a testing time representing 10 per cent of expected operating life, and, as a starting point, a minimum price per gyro of $2,000, which includes the cost of 50 hours of test time. For longer periods of testing, the price, and the Cost per Use Hour, will change as shown in Table 1 and Figure 3.

Table 1 draws on experience: for gyros priced at $4,000 and less, the amount of testing done is not usually sufficient to certify the condition of the spin-axis bearings and the uncertainty of the precession axis. This is for reasons of cost. As the price rises, more significant testing for these two qualities is added to the test program. As a result, the overall quality of the gyro is expected to be better. Higher acquisition price must be associated with specifications for higher quality and longer life.

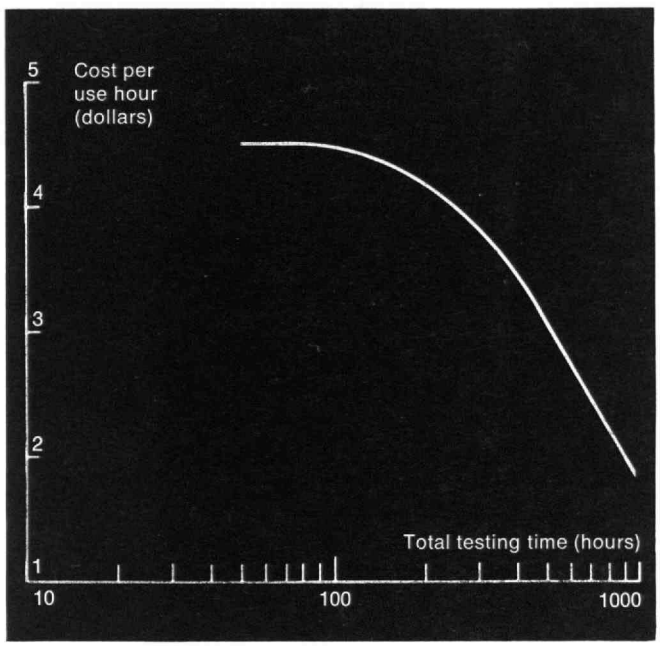
Total testing time (hours)	Acquisition price	Cost per use hour
50	$ 2,000	$4.50
100	4,000	4.50
150	6,000	4.50
250	9,000	4.00
450	12,000	3.00
750	15,000	2.20
1,000	17,000	1.90

Testing of the spin-axis bearings for the lower-price gyros consists primarily of ascertaining that the wheel will start at a specified voltage and that this starting requirement is met for some minimal number of running hours (48 hours or less). Similarly, the number of starts will probably be limited to less than 20. These limitations mean that the findings say nothing significant about behavior beyond 1,000 hours, and indeed may preclude ascertaining a life as long as that. Remember, though, that this situation is dictated by price and not by negligence or by evil intent.

As a higher acquisition price is allowed, the spin-axis bearings can be tested with higher caliber equipment. More time can be devoted to testing precession-axis-bearing uncertainty, and this longer time-span itself adds to the assurance of reliability.

Table 1 and Figure 3 enable us to determine what the price would have to be if, for gyros with 500- or 1,000-hour expected total operating life, we could stipulate the same Cost per Use Hour—$1.90 per hour—as for the $17,000 gyro. The answer proves to be $850 for the 500-hour gyro ($1.90 x 450 useful-life hours) and $1,700 for the 1,000-hour gyro, as against the tabulated figures of $2,000 and $4,000, respectively. If you know where you can buy such a gyro for $1,700 or less with a Reliable Performance Life of 900 hours (1,000 total less 100 test hours) you are indeed fortunate!

Cost per Use Hour, as considered in this paper, is strictly an amortization cost for the acquisition price of



the gyro. It does not allow for installation or removal costs. Obviously, shorter-life gyros incur these costs more often; and although such a gyro may be replaced or repaired at lower cost than a more expensive gyro, installation and removal also represent real costs associated with the gyro. Add to this the lower-price gyro's expected greater hazard of failure and loss of mission or equipment, and a new meaning of cost effectiveness begins to appear.

The effectiveness of a complete vehicle, and perhaps its utility and safety, depend critically on the gyro. For an airplane, the total equipment cost of the plane and avionics will today be in the region of $12 million to $15 million. Why use a $300 gyro with no valid test experience?

Table 1 appears to indicate that testing alone adds considerably to instrument cost. This itself is true, since some types of testing can involve both expensive equipment and many technical workers. However, what is more important is the fact that the requirement for added testing before delivery and for more indicative test results places a much greater responsibility for reliability and performance on the manufacturer.

Suppose we require a gyro with a total operating life, or Reliable Performance Life, of 4,500 hours, and that we apply the 10-per-cent criterion and demand a test program of 450 hours. Table 1 shows that if the manufacturer tried to fulfill the requirement with the $2,000 gyro he would be testing it essentially to extinction; and he would test a $4,000 gyro to half-life. Presumably his in-house failure rates in both cases would be prohibitive (he would be taking the gyros to the far right of the bathtub curve), and he would either have to put more gyro assemblies in the production line to meet the delivery requirements, or else basically improve the design. Either way, his building costs, apart from his testing costs, would markedly increase, and he would no longer be marketing a gyro priceable at $2,000 or $4,000. In fact, he should not have been trapped into trying to do so. (Whether the manufacturer trapped himself or the purchaser allowed him to be trapped is not pertinent to this paper!)

The Well-Equipped Buyer

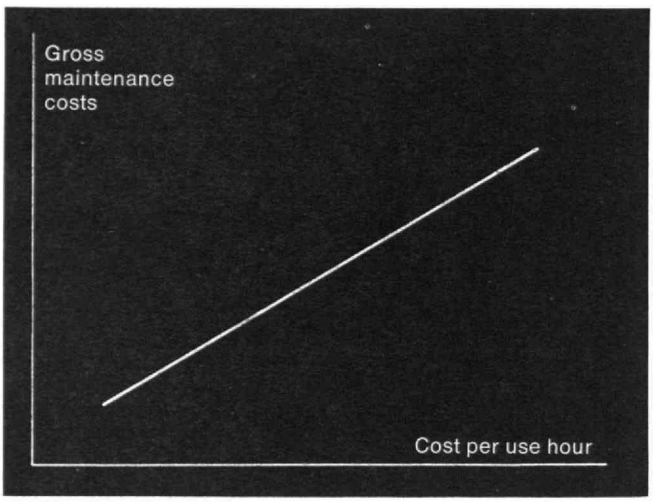
Something that has so far only been implied in this paper should be brought out: the engineering capability of the purchaser has to be quite significant. At the least, my recommendation for rather complete stipulation of the required test program and of the test results within the contract (or as auxiliary documents) implies that the contracting party must have adequate engineering assistance in drawing up the contract and in selecting the supplier. With such stipulations in the contract, no supplier should be able innocently to offer what turns out to be an inferior or inadequate item, merely because there has been no testing to reveal the true relationship between its quality and the need. On the other hand, pricing too will have to be on the basis of these contractual stipulations.

For the purchaser and the manufacturer, using the gyro as the example, the benefits of increased testing are significant. Spending more hours on testing spin-bearing operation and gyro uncertainty, and on correlating the resulting data, leads to improved reliability, construction techniques, and output (for a given building effort).

Attitudes toward Costs

Attitudes to testing are most often dictated by attitudes to acquisition cost. If the buyer favors low initial outlay, testing will be severely limited. Sometimes the buyer has enough foresight to be able to combine reasonable maintenance costs with low initial cost: if a low initial

The relationship between maintenance cost and cost per use hour shown below follows from the evidence on pages 34 and 35 that lower cost per use hour is achieved with gyros with longer expected operating life. Less maintenance time is associated with a gyro that needs less frequent replacement.



price can purchase enough reliability to keep maintenance costs within bounds, this is a reasonable approach. But all of the foregoing discussion argues against this possibility being a reality.

Most often the low-initial-cost enthusiast takes it for granted that the only thing he is sacrificing is needlessly high performance. "Adequate" reliable life is still expected, but this expectation often turns out to be unfulfilled. Certainly it is the experience of our laboratory that Reliable Performance Life is a single entity, rather than three factors engineered in separately and independently.

In the gyro example, all too often the costs of installing and removing the gyro for maintenance—perhaps removing large assemblies just to gain access to it—are overlooked. They certainly should be regarded as part of the total cost, as should an "out-of-service" charge for equipment, for example an airplane, in a nonoperative state while removal and installation work is going on.

Gross maintenance cost can be considered to increase with increasing Cost per Use Hour, somewhat as in Figure 4. This follows from Table 1 and Figure 3, which indicate that lower Cost per Use Hour is achieved by using gyros with a longer total operating life. (Less maintenance activity is needed by a gyro that needs replacing less often.) Table 1 and Figure 3 are in turn based on experience indicating that the gyro that costs less per hour of use is the result of higher purchase price and more testing, forcing an upgrading of the design, the manufacturing methods, or both.

As well as Demands, Incentives

Thus far, this paper could be interpreted as a scheme to nail the supplier to the wall, and in a sense it is. However, it is also meant to nail the purchaser to the same wall, in the sense that he must be prepared to pay for that which he demands in his contract.

In addition, a good contract should give the supplier some added incentive to better his product—to surpass the specifications. He will do this most conveniently by achieving a higher percentage of deliverable items. I now present a plan for capitalizing on that method.

To start with, the contract should define performance and yield (percentage of acceptable items) so as to provide room for incentive.

An incentive which rewards, with a reduced test program, the achievement of a higher yield, needs to accomplish this without watering down the requirements. This can be done by adding a second test, called an "assurance test," which is imposed on all items passing the initial test if less than a certain percentage do so. The assurance test can, if desired, be made more severe than the initial test.

For example, if the initial testing fails less than 10 per cent of the units tested, only one in six must receive the second test. But if the failure rate during the assurance test is itself greater than 10 per cent, all items must have the assurance test.

Any item failing a retest (repeat of first test) or failing the assurance test is an absolute reject (subject only to prestipulated waiver conditions).

All this is shown schematically in Figure 5. The ratios and other variables can be changed to suit the needs of the program. The point is: better product—less testing—more profit for the supplier (and a more reliable item for the purchaser).

It is common practice, rightly or wrongly, to use "on-hand" equipment for years and years in spite of any deficiencies and in spite of absurdly high maintenance costs. So the problem facing our nation is how to get

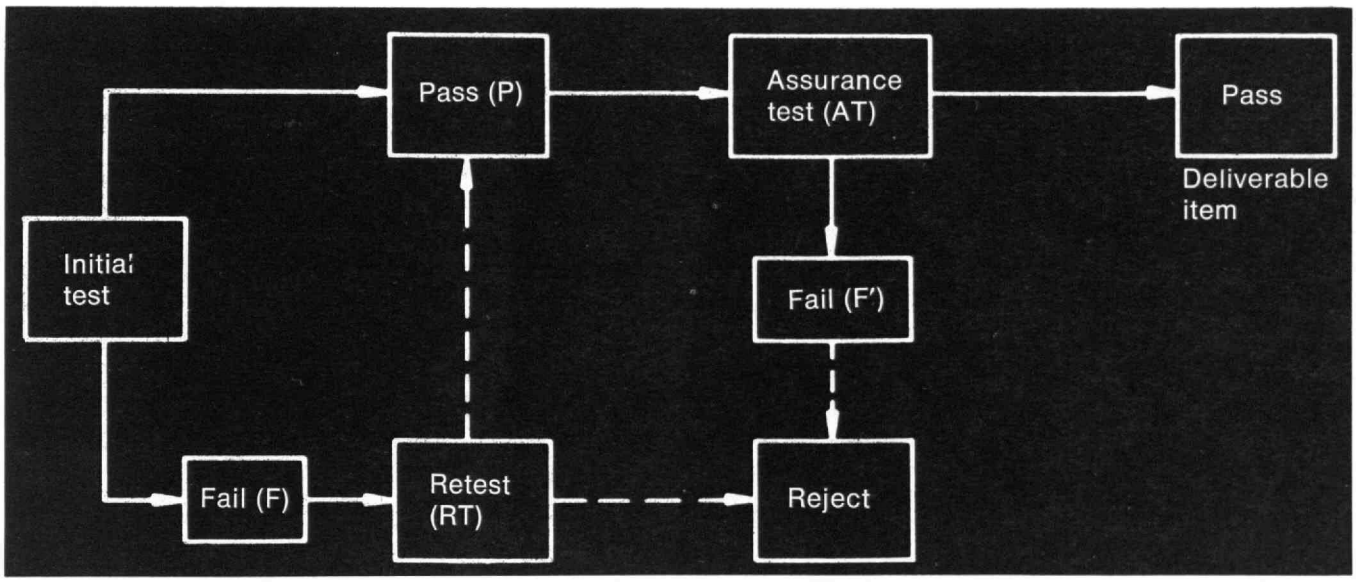
To assure quality, the author suggests that a second test—an "assurance test" stage—can be added if the proportion of production passing an initial test is too low. In every respect, the assurance test will help by clarifying the results; items must in effect pass (or fail) two tests before acceptance (rejection).

$$\text{If } \frac{F}{P+F} > \frac{1}{10};\ AT = P$$

$$\text{If } \frac{F}{P+F} \leqq \frac{1}{10};\ AT = \frac{P}{6}$$

$$\text{If } \frac{F}{P+F} > \frac{1}{10};\ RT = 0$$

$$\text{If } \frac{F'}{AT} > \frac{1}{10};\ AT = P$$



high-performance reliable equipment in order to move forward, in the face of the heavy drain of a very unpopular war and a shrinking military budget.

At the very least, forward purchasing should realistically look at total costs in their proper perspective.

Suggested Readings

William G. Denhard, *Reliability Enforcement in Design (Using Gyroscopes as an Example),* Memo WGD-69-40, Charles Stark Draper Laboratory, M.I.T., September, 1969.

William G. Denhard, "Cost versus Value Considerations in the Selection of Ball Bearings," a paper to be delivered at the A.S.M.E. Design Engineering Conference, May 11-14, 1970, Palmer House, Chicago.

Hudson B. Drake, "Major D.O.D. Procurements at War with Reality," *Harvard Business Review,* January/February, 1970.

Michael Getler, "Apollo: Was It Worth It?" *Space/Aeronautics,* September, 1969.

Arthur C. Metzger, *An Integrated Test System (ITS) in the Post-Apollo Era,* Office of the N.A.S.A. Representative, Charles Stark Draper Laboratory, M.I.T.

Wayne E. Meyer, "Age versus Reliability," *Ordnance,* January/February, 1970.

Following his graduation in electrical engineering from M.I.T. (S.B. 1942), William G. Denhard worked with heavy mechanical equipment for railroad operation and construction machinery for six years before returning to M.I.T.'s Charles S. Draper (then Instrumentation) Laboratory. Since then he has been involved with the precise instrumentation, required to demonstrate the utmost in performance and reliability, which is the subject of the example chosen for this article. Mr. Denhard is now an Associate Director of the Draper Laboratory.

Can the negotiators at the Strategic Arms Limitation Talks in Vienna overturn the tradition of "avoiding the hard political and economic decisions that would make possible genuine disarmament of both nuclear and conventional weapons"? Once more, writes the author, "we have the chance . . . to stop wasting so large a part of our creative energies thinking about the unthinkable and our productive capacities producing the unusable." (Photo: the Palace Eugene, Vienna, by Ewing Galloway)

The Strategic Arms Limitations Talks provide the U.S. with one more opportunity to enhance its own national security while joining a world movement which can only yield a higher quality of life for all peoples

Jerome B. Wiesner
Provost of M.I.T.

Memorandum to a Vienna Negotiator

I do not know how to diagnose the prospects for disarmament. In one sense, I could say that they are good because there are so many opportunities. But if one judges by the past, he has to anticipate that we will pass most of them up, doing just enough to avoid catastrophic wars but carefully avoiding the hard political and economic decisions that would make possible genuine disarmament of both nuclear and conventional weapons. There are those, particularly among our militant students, who are convinced that the nature of our economic system and particularly the needs of our overseas commerce require a large military effort and consequently that no nation with vested military interests can in fact make an honest and complete effort to achieve disarmament. It is true that economic interests have often painfully dominated our foreign policy, particularly in Latin America. But practical, safe arms reduction and restriction is easy to achieve from a technical point of view, and there are many, many ways to reduce the scale of national military efforts which would indeed enhance the security of all nations, large and small.

Educating the National Leadership

One of the most fascinating aspects of my 12-year involvement with disarmament efforts has been to watch the conversion of a succession of American political leaders to disarmament advocates as they have become increasingly frustrated with military efforts to insure national security. This conversion has inevitably happened to presidents, to most cabinet officers, and to most presidential assistants. As a striking example of this, all of President Kennedy's senior national security aides, including the Secretaries of State and Defense, have become strong advocates of arms limitations—McNamara before his retirement, Rusk afterwards. If these gentlemen had worked to limit the arms race instead of supporting it during the early 1960's, our country probably would not be in its present state of chaos and despair. In fact, I believe that one of the greatest challenges before us as we work on these problems is to speed up this almost inevitable enlightenment of public figures—or, to put the question simply, to develop understandings which will prevent several years of disastrous arms escalation each time the national leadership changes and the new leaders learn all over again that supporting the arms race inevitably increases our danger.

The United States has lost many opportunities to halt the arms race since Harold Stassen's initial effort in 1955-1956, when he negotiated a tentative agreement on the control and limitation of bombers and nuclear testing in a conference that included representatives of the Soviet Union, the United Kingdom, France, and the United States. But this agreement finally failed of approval because of the great promise of two new technical developments, the ballistic missile and the "clean" thermonuclear weapons advocated by Edward Teller and Admiral Lewis Strauss. In 1958 a proposal to seek an agreement to halt missile tests was not pursued because of a judgment that the Soviet ballistic missile development was too far along to be stopped by a ban on test flights; in retrospect, however, I believe that a ban on ballistic missile testing in 1958 or even 1959 could have shut off the missile race.

Again in 1961, at the start of the Kennedy administration, we had an opportunity to freeze the ballistic missile force at the relatively low levels proposed by President Eisenhower. After taking office, we learned that the Soviet missile force was substantially smaller than the estimates—largely leaked by Congressional sources—which provided the basis for the so-called missile gap. We learned, in fact, that the U.S. probably had more missiles than the Soviet Union—a somewhat surprising, reassuring, and confusing fact. At that time, some persons within the government proposed holding down the U.S. missile levels in the expectation that if the United States showed restraint the Soviet Union might be persuaded to do the same and that—in any event—a force of 200 to 400 Polaris, Titan II, and Minuteman missiles would be a mighty deterrent against any likely Soviet strategic force. At that time the Air Force wanted 3,000 new Minuteman missiles. At the same time the Navy proposed increasing the Polaris submarine fleet to 41. Secretary McNamara's recommendation finally was for 950 missiles and a force of 41 Polaris submarines. The only understandable explanation given by Secretary McNamara for this recommendation was that in view of the Air Force request 950 was the smallest number he could imagine asking Congress for and (in his words) "not get murdered." Ultimately, the President was convinced of this too and reluctantly agreed to the Secretary's proposal. Only the future got murdered.

For many years, the Soviet Union's leaders appeared to be willing to allow the United States to have a very

substantial numerical superiority in ballistic missiles. However, with the deployment of the SS-9 missile and more SS-11s during the past year, the Soviet Union has equaled and may even have surpassed the U.S. land-based missile force. So, today we have to face the question of an appropriate U.S. response to the latest Soviet response to an unnecessary U.S. response.

It is not only a time to think about a response; it is a moment to realize that the United States could stop the upward spiral of the arms race by the proper response. It is also almost the last moment when President Nixon can avoid taking that next turn on the ratchet which would hoist the arms race into new levels of dangers and costs. It is President Nixon's moment to see if he can avoid the costly opening mistake with which each of his recent predecessors began his presidential career.

Inevitable Devastating Retaliation

Both the President and the leaders of the Soviet Union seem to be fully aware of the situation, for they have undertaken the Strategic Arms Limitation Talks (S.A.L.T.) specifically to see if it is possible to avoid the escalation of the nuclear arms race. Unfortunately, the President has also made a decision to respond to the recent Soviet missile build-up with an initial deployment of the worthless Safeguard antiballistic missile (A.B.M.) system and of the as yet incompletely tested multiple-warhead (M.I.R.V.) systems for the Minuteman and Polaris missile force. I suspect the rationale is that if S.A.L.T. goes well these systems could be stopped; and if S.A.L.T. does not make progress we would have whatever added security the systems might provide. But in fact the pace of S.A.L.T. is likely to be such that both of these systems will be far advanced by the time agreement might be reached. My urgent thesis is that the United States—and the rest of the world, too—would be better served by a halt now in the deployment of the A.B.M. system and in the continued testing and deployment of the M.I.R.V. systems, coupled with a challenge for the Soviet leaders to show similar restraints.

I believe that this would be the wisest course for our country to follow. It would also be the most sensible course for the Soviet Union. There is a symmetry here: if the Soviet Union joined in the moratorium, it could be continued indefinitely; otherwise future U.S. deployment decisions could be related to further Soviet actions.

The U.S. A.B.M. is a response to the SS-9 and SS-11 missiles (somewhat less than 300 of the former and several hundred of the latter) now deployed by the Soviet Union. In discussing the impact of these weapons on the current deterrent balance, the Department of Defense has assumed that the U.S.S.R. would continue to manufacture and deploy them, until by 1975 there would be 500 or more of each. The Department has also assumed that the SS-9 would be equipped with a highly accurate M.I.R.V. system which does not now exist.

The U.S. M.I.R.V.'s are proposed as a means of assuring that U.S. missiles could penetrate a Soviet A.B.M. system should it be deployed. In other words, both of these escalatory steps are proposed to insure that our deterrent would remain effective if these two possible Soviet deployments occurred on the scale assumed. Here we have the arms race in its purest form. I do not believe that any responses need to be taken at this time to deal with these eventualities, and furthermore I believe that the Safeguard A.B.M. system is as poor a way as one could possibly find to insure survival of the American retaliatory capacity were it in jeopardy.

The arguments for and against the Safeguard system as a means of protecting the U.S. deterrent—in particular the Minuteman missiles and B-52 bombers—against the SS-9 force were presented at great length a year ago. It became very clear then that the A.B.M. system would do little good and, even more important, that it was not needed to protect the U.S. deterrent. It is easy to show that a massive U.S. deterrent force, including more than 200 Minuteman missiles, a major fraction of the bomber force, the Polaris force and several thousand fighter-bombers capable of carrying nuclear weapons, would survive an all-out SS-9 M.I.R.V. attack, even of the size and character conjured up for 1975 to frighten the Congress. And even if the Soviet Union did deploy an extensive A.B.M. system to blunt a retaliatory strike by the surviving U.S. force, it would not be possible for them to prevent an unacceptably large blow from landing.

This is the vital point. Given the offensive systems already in existence, there is, I am convinced, no attainable combination of attack and defense which would prevent either the Soviet Union or the United States from having to face a devastating retaliatory blow if either one initiated a nuclear exchange. We have become numbed by the number games we play with nuclear weapons and have lost track of their power and what a few of them can do.

It is hard to know just what constitutes a deterrent, and so we go to extremes. The strategic analysts have a fairly sophisticated view of a deterrent wrapped up in a concept called "assured destruction" which requires the clearcut ability—on paper—to follow the most sophisticated Soviet attacks of which we can conceive with a U.S. retaliation which can kill some large fraction (40 to 50 per cent) of the Soviet population and destroy most of its industrial enterprise. Less than 400 one-megaton bombs appropriately scattered about are required to ensure this level of damage. This is clearly an upper bound on a deterrent; but it is somewhat modest when compared to the forces we—or, for that matter, the Soviet Union—now maintain. There is one piece of data which establishes a lower bound—perhaps somewhat lower than would leave us feeling comfortable; it is the fact that Stalin was clearly deterred in the period immediately after World War II by the existence of a very few 20-kiloton U.S. nuclear bombs. I am in fact convinced that the high probability that six out of ten of a nation's largest cities could be destroyed and a substantial fraction of their residents killed will function as an effective deterrent against any but the most fear-driven action. The lower limit to a deterrent, then, might be the force which could deliver six modern nuclear weapons on city targets. (Even this number seems high to me, but if it is too low for you, make it 20.).

The key issue is to examine the chances that the

Soviets could prevent at least that number of our warheads—six, or 20—from reaching their cities by any of the actions that have been proposed or are imaginable for 1975 or even 1980. I have already talked about the forces that would survive the best attack the Soviets could launch in 1975 using the forces that Defense Secretary Laird projects for them. This surviving force could include several hundred missiles—perhaps 200 Minuteman and 300 to 600 Polaris missiles—and at least several hundred aircraft.

A year ago, when Department of Defense representatives saw our calculation of the number of Minuteman missiles that would survive the SS-9 attack they postulated for 1975, they gave the SS-9 system a new capability: the ability to be retargeted in flight to allow for a second attack on those targets that had been spared by failures in the first wave of missiles. By doing this and making very optimistic assumptions regarding the reliability of each of the elements of the SS-9 system, they were able to bring their estimate of the number of surviving Minuteman missiles down to 50. But this is still more than 20, so that the surviving Minuteman force alone would provide a more than adequate deterrent by reasonable standards. Double the number of SS-9s and even then a few Minuteman missiles would survive. (Incidentally, if we should ever find ourselves in this situation and were a bit worried about it on second thought, we would only have to promise to fire the Minuteman missiles after the first bombs have fallen on the U.S. to raise the number of retaliatory weapons dramatically.)

The Irrelevance of Defense

How might conceivable Soviet defenses change this situation? It is hard to be very specific, for we must make so many assumptions about the crisis performance of untestable defensive systems. No expert expects aircraft defenses to intercept as much as 50 per cent of an attack, and the Vietnam experience would certainly support this. (Though aircraft may not be as good as missiles for carrying out a surprise attack, they remain an effective retaliatory weapon.) But assume that Soviet air defenses are vastly improved and are 90 per cent effective—a highly unlikely achievement. Then if only 1,000 U.S. aircraft are available, 100 will reach their targets.

There are as yet no reliable signs of a large-scale Soviet antiballistic missile system, although from time to time that part of the defense technology community that believes that the Russians are 12 feet high puts forward the claim that the Soviets are converting a part of their air defense system into an A.B.M. system. For the moment, let's assume that such a conversion occurs. What will be the situation then? For the sake of argument, assume that the Soviet A.B.M. system is 50 per cent effective—that is, intercepts half of the incoming objects. (Actually, I do not believe that any A.B.M. system so far developed would function at all against a substantial attack, but I have to assume something to make my argument.) Of the 50 Minuteman and 325 Polaris missiles (half the fleet) available after the imaginary SS-9 attack on the U.S., more than 150 would arrive at their targets. If the Soviet A.B.M. system achieved such a fantastic capability as 90 per cent, more than 30 U.S. missile warheads would still get through to their targets. As I said earlier, in a really worrisome situation a fire-after-the-first-explosion doctrine would make many more Minuteman missiles available.

Clearly then, neither A.B.M.'s nor M.I.R.V.'s are necessary to insure a deterrent capability no matter what the Russians choose to do. If they want to waste their money on A.B.M.'s and hundreds more SS-9s and M.I.R.V.'s—which incidentally I really doubt—well then, let them do it.

We should halt all new missile and M.I.R.V. testing and deployment and stop the Safeguard A.B.M. deployment for all time. We should simultaneously ask the Russians to join us. The S.A.L.T. negotiations should then be used to formalize such arrangements and—equally important—to seek agreements to reduce the size of the strategic forces.

Disarmament as a Political Issue

The principal arguments that will be made against this proposal are political ones—that we will lose our bargaining position at S.A.L.T. because in a serious confrontation the leader with the greater strategic force behind him will show the greatest staying power. There may be some psychological advantage in having a superior force, but it is not on balance a major factor. Examination of nuclear-age crises over Berlin, the Suez Canal, Cuba, and Hungary shows that their outcomes were determined more by the recognition of each side's vital interests by the other than by the strategic balance in determining their outcomes.

The aspect of the efforts to stop the arms race that I find most frustrating is our inability to create strong pressures for its deescalation, compared to those that generated it and keep it going. Many forces sustain the arms race. Anticommunism has been so virulent in the United States that it will almost certainly one day be viewed as a mental disease which has led us to many self-destructive acts. Many false images of the United States have guided Soviet policy. These pressures have made it very easy to motivate the United States to carry out its part in the arms race, and apparently similar reactions have been aroused without difficulty in the Soviet Union. On the other hand, there seem to be no "natural" forces acting to accelerate a peace race. Quite the contrary. The sad fact is that whenever we succeed in making a moderate step in the direction of slowing down the arms race, the ensuing euphoria is counterproductive.

At least until now the principal pressure for nuclear disarmament has come from the fear of mutual annihilation, and this is an issue only evident during crisis periods. In the case of the cessation of nuclear testing there was the additional pressure of health hazards from radiation, and I am persuaded that the fear of radiation, rather than the concern over nuclear war, made possible the Limited Test Ban Treaty. But following the signing of the Test Ban Treaty and the consequent elimination of the fallout hazard, enthusiasm for further arms control measures disappeared. Only with the appearance of

new threats—the development of nuclear weapons by the Chinese, the war in the Middle East and in Vietnam, the repression of Czechoslovakia, and our domestic fiscal crisis—has serious interest in major arms reductions been revived. The fiscal and social crisis in the United States and the extreme pressures for economic development within the socialist block may provide some of the positive pressures that are needed to bring about serious disarmament efforts.

Numerous proposals have been made for building more positive feedback for disarmament into the arms control agreements themselves. In particular, a number of schemes have been put forward to increase the incentives for reaching agreements. For example, it has been suggested that a fraction of the savings that accrue from arms control be used to support international development efforts. This would give the underdeveloped countries an incentive to work for disarmament. I have previously proposed that the United Nations peace-keeping forces be financed by a levy on the member nations; the size of the levy to be directly related to the arms expenditures of each nation. The countries with the largest expenditures for armaments would then have to bear the largest share of the cost of the international security forces of the United Nations.

Though most of this discussion has been focusing on nuclear weapons, achieving limitations on conventional weapons—particularly the more sophisticated and costly varieties—is an equally vital problem that affects many more nations than do the nuclear agreements. These issues have disappeared from the disarmament agenda—perhaps out of frustration, possibly for fiscal reasons. All the major powers sell weapons through economic as well as political motivations. The United States is the largest merchandiser of sophisticated weapons of war, followed closely by the Soviet Union, France, and Britain. We should take the lead in halting or at least greatly reducing this immoral traffic, and to do this we should take the lead in building up the United Nations peace-keeping forces.

The U.N. in Disarmament

Indeed, the whole status of the United Nations requires attention. We cannot escape the fact that a series of unilateral actions by member nations has eroded both the power and esteem of the United Nations to the point where it is incapable of dealing effectively with any serious crises. Many nations—but most notably the United States, France, and the Soviet Union—have been guilty by action and inaction. Instead of subordinating parochial interests and local worries and accepting some compromises in order to build up and enhance U.N. power, authority, and prestige, we have behaved in such a way as to render it less able to deal with a crisis today than it was a decade ago. The hopes and dreams focused on the U.N. by people everywhere as they dug themselves out of the rubble of World War II remain unfulfilled. Each passing year, as the scars of that war have been eliminated and its memories have dimmed, member nations have been less willing to sacrifice anything at all, particularly pride, or even to reexamine the old political cliches, in order to effect a more liveable world.

To achieve effective arms control the United Nations should have an augmented observer force of at least 2,000 men directly under the control of the Secretary-General, and it should have available a large stand-by military force subscribed by the member nations, also under control of the Secretary-General.

Financing will have to be solved. Ultimately, $400 million a year, 5 per cent of the cost of the space race, would be needed to support adequately the peace-keeping effort—0.2 per cent of the world's military budgets.

The political problems associated with strengthening the U.N. peace-keeping effort are also challenging. Clark and Sohn in their book, *World Peace Through World Law,* suggested that the U.N. Charter be revised to give that organization more authority and to provide an effective political management for the peace-keeping forces. Such proposals have not been attractive, for they require sovereign nations to give up some of their sovereignty and they also imply a change in the present pattern of representation in the United Nations. Yet I do not see how we can create the kind of world we want unless we are prepared to face these questions.

The task today is the same as it always has been: to eliminate national military forces and substitute an international security system—that is, an international military system supported by an international legal system, the whole backed by reliable financing. Until these objectives are truly achieved, the world will continue to stumble along the brink of disaster, its fate in the hands of the least stable countries and leaders. Despite some disagreement on details, I believe that these questions could be resolved if people became convinced that the major goal of genuine disarmament was really attainable and was the surest route to survival.

Toward a Permanent Disarmament Conference

Here are a number of proposals, mostly made before, that I now set forth as part of a program to move speedily toward real disarmament.

First, we should replace the Eighteen-Nation Disarmament Conference with a better staffed and more effective organization for studying, negotiating, and implementing disarmament measures. We must increase the role of the United Nations in these efforts. One way to do this would be to establish a full-time deputy to the Secretary-General to be responsible for directing the disarmament effort. This new U.N. Deputy Secretary-General for Disarmament should be supported by an expert staff that would carry out independent studies of disarmament matters and advise him on technical and legal questions. The Deputy Secretary-General for Disarmament should also be the chairman of a reorganized and strengthened Eighteen-Nation Disarmament Conference. The present membership of the Conference should be reviewed and such obvious omissions as the Chinese People's Republic be corrected. Working groups would be needed related to the major disarmament issues: legal and judicial systems, reforms in the United Nations Charter, the elimination of national military forces, peace-keeping arrangements, and inspection arrangements. The U.N. disarmament staff and

the various national participants would be charged with providing definitive proposals to be considered by the subcommittees of the Conference. The Conference would, in turn, make recommendations to the General Assembly.

Second, to give added consideration and weight to disarmament efforts, I propose that once a year the Secretary-General of the United Nations convene a meeting of the heads of state of the permanent members of the Security Council to consider the recommendations of the Disarmament Conference, to review progress made during the previous year, and to chart the work for the following year. Diplomats will object to this on the grounds that heads of state should meet only after agreements have been reached at a working level; otherwise, so the argument goes, false expectations will be aroused among us common people and the resulting disappointment will be counterproductive. There may be some point to this reasoning when an isolated heads-of-state meeting is convened in the midst of a severe crisis—practically the only circumstance under which heads of state now take the time to talk together about the international situation. But if the meetings were scheduled regularly and the Assembly had continuing and specific responsibility to get on with the disarmament effort, the situation would be different. The work of the Disarmament Conference would then have a focus; targets would be set for each year by the heads of state, and they would periodically review progress. This arrangement would also give the heads of state a better understanding of the issues and of each other's points of view and worries, a not inconsequential gain. Furthermore, it would put the prestige of the heads of state behind the effort and thus give disarmament a much-needed boost in priority, possibly generating some of that positive feedback I wanted earlier. Only if disarmament can be given such a priority can it overtake the arms race.

Much thought has been given to the basic problem of financing U.N. operations, particularly its peace-keeping activities, and more is needed. At this point I believe that a U.N. force, sizable enough to cope with national forces and capable of providing acceptable international security, would ultimately cost in the neighborhood of $3 billion annually. I would suggest an initial budget of $400 million per year. From this modest start to the ultimate force, the cost would increase by a factor of about seven. National budgets for military purposes total approximately $200 billion. A levy of 1/3 of 1 per cent on military budgets would provide the money needed to support the U.N. force. Ultimately, the cost of supporting the U.N. activities should be prorated in accordance with the total national income of the member nations. Initially, however, I prefer to make the cost to each nation proportional to military expenditures. The rate of increase toward the ultimate $3 billion should be developed on an agreed-upon schedule to make available the funds needed for the growing peace-keeping activities, the actual amounts depending, to a large degree, upon how rapidly national expenditures for military purposes are reduced, and on how the costs of the U.N. peace-keeping effort can themselves be reduced. In addition, it would be well as peace-keeping costs decline to commit some fraction of the savings to U.N. investments for nation building, but that goes beyond the subject at hand.

Finally, I would like to stress a few general points. First, the membership of the United Nations should be expanded to include all the nations of the world and particularly the Chinese People's Republic. Second, a means must be found to disengage the United States and the Soviet Union from the conflicting responsibilities and commitments they have in several regions of the world. These problems simply must be placed in the hands of a neutral group, possibly a group of smaller nations increasingly willing to accept responsibility within the U.N. Unless this is done, many international difficulties will persist and make it difficult to give adequate attention to the long-term disarmament tasks.

For the past 20 years American leaders have opted for a military superiority whose only tangible result has been a continuing arms race in which the price of leadership has been the degradation of our society, the disappearance of our pride in nation, and the total abdication of our traditional role of political and moral leadership in the world. America, the land of the free and home of the brave, has become the land of the fearful, hiding behind a meaningless nuclear overkill. We have the chance once again to save ourselves, to change directions, to reject the arms race as a way of life, and to stop wasting so large a part of our creative energies thinking about the unthinkable and our productive capacities producing the unusable. How many more opportunities remain to us?

Jerome B. Wiesner first came to M.I.T. in connection with work in the communications sciences and was Director of the Research Laboratory of Electronics before joining President John F. Kennedy's staff as Assistant to the President for Science and Technology. He remains active in political affairs on local, state, and national levels while, as Provost, having principal responsibility for M.I.T. academic affairs. This article has been developed from an address by Dr. Wiesner at the 1969 annual meeting of the American Association for the Advancement of Science, and it appears here through the cooperation of the Editors of Science and Public Affairs.

Transfers of energy are commonplace, and we are all familiar with their damaging consequences when the object or subject are out of control. Finding that energy-transfer events are seldom studied in an organized way, the author proposes a systematic analysis which can help in selecting the options and strategies open for control. (Photo: Harold E. Edgerton)

William Haddon, Jr., M.D.
President, Insurance Institute for Highway Safety

On the Escape of Tigers: An Ecologic Note

A major class of ecologic phenomena involves the transfer of energy in such ways and amounts, and at such rapid rates, that inanimate or animate structures are damaged. The harmful interactions with people and property of hurricanes, earthquakes, projectiles, moving vehicles, ionizing radiation, lightning, conflagrations, and the cuts and bruises of daily life illustrate this class.

Ten Strategies for Reducing These Losses

Several strategies, in one mix or another, are available for reducing the human and economic losses that make this class of phenomena of social concern. In their logical sequence, they are as follows:

The *first* strategy is to prevent the marshalling of the form of energy in the first place: preventing the generation of thermal, kinetic, or electrical energy, or ionizing radiation; the manufacture of gunpowder; the concentration of U-235; the build-up of hurricanes, tornadoes, or tectonic stresses; the accumulation of snow where avalanches are possible; the elevating of skiers; the raising of babies above the floor, as to cribs and chairs from which they may fall; the starting and movement of vehicles; and so on, in the richness and variety of ecologic circumstances.

The *second* strategy is to reduce the amount of energy marshalled: reducing the amounts and concentrations of high school chemistry reagents, the size of bombs or firecrackers, the height of divers above swimming pools, or the speed of vehicles.

The *third* strategy is to prevent the release of the energy: preventing the discharge of nuclear devices, armed crossbows, gunpowder, or electricity; the descent of skiers; the fall of elevators; the jumping of would-be suicides; the undermining of cliffs; or the escape of tigers. An Old Testament writer illustrated this strategy in the context both of the architecture of his area and of the moral imperatives of this entire field: "When you build a new house, you shall make a parapet for your roof, that you may not bring the guilt of blood upon your house, if any one fall from it." (Deuteronomy 22:8). This biblical position, incidentally, is fundamentally at variance with that of those who, by conditioned reflex, regard harmful interactions between man and his environment as problems requiring reforming imperfect man rather than suitably modifying his environment.

The *fourth* strategy is to modify the rate or spatial distribution of release of the energy from its source: slowing the burning rate of explosives, reducing the slope of ski trails for beginners, and choosing the reentry speed and trajectory of space capsules. The third strategy is the limiting case of such release reduction, but is identified separately because in the real world it commonly involves substantially different circumstances and tactics.

The *fifth* strategy is to separate, in space or time, the energy being released from the susceptible structure, whether living or inanimate: the evacuation of the Bikini islanders and test personnel, the use of sidewalks and the phasing of pedestrian and vehicular traffic, the elimination of vehicles and their pathways from community areas commonly used by children and adults, the use of lightning rods, and the placing of electric power lines out of reach. This strategy, in a sense also concerned with rate-of-release modification, has as its hallmark the elimination of *intersections* of energy and susceptible structure—a common and important approach.

The very important *sixth* strategy uses not separation in time and space but separation by interposition of a material "barrier": the use of electrical and thermal insulation, shoes, safety glasses, shin guards, helmets, shields, armor plate, torpedo nets, antiballistic missiles, lead aprons, buzz-saw guards, and boxing gloves. Note that some "barriers," such as fire nets and other "impact barriers" and ionizing radiation shields, attenuate or lessen but do not totally block the energy from reaching the structure to be protected. This strategy, although also a variety of rate-of-release modification, is separately identified because the tactics involved comprise a large, and usually clearly discrete, category.

The *seventh* strategy, into which the sixth blends, is also very important—to modify appropriately the contact surface, subsurface, or basic structure, as in eliminating, rounding, and softening corners, edges, and points with which people can, and therefore sooner or later do, come in contact. This strategy is widely overlooked in architecture with many minor and serious injuries the result. It is, however, increasingly reflected in automobile design and in such everyday measures as making lollipop sticks of cardboard and making some toys less harmful for children in impact. Despite the still

only spotty application of such principles, the two basic requisites, large radius of curvature and softness, have been known since at least about 400 B.C., when the author of the treatise on head injury attributed to Hippocrates wrote: "Of those who are wounded in the parts about the bone, or in the bone itself, by a fall, he who falls from a very high place upon a very hard and blunt object is in most danger of sustaining a fracture and contusion of the bone, and of having it depressed from its natural position; whereas he that falls upon more level ground, and upon a softer object, is likely to suffer less injury in the bone, or it may not be injured at all . . ." ("On Injuries of the Head," *The Genuine Works of Hippocrates,* trans. F. Adams [The Williams and Wilkins Co., Baltimore, 1939]).

The *eighth* strategy in reducing losses in people and property is to strengthen the structure, living or nonliving, that might otherwise be damaged by the energy transfer. Common tactics, often expensively underapplied, include tougher codes for earthquake, fire, and hurricane resistance, and for ship and motor vehicle impact resistance. The training of athletes and soldiers has a similar purpose, among others, as does the treatment of hemophiliacs to reduce the results of subsequent mechanical insults. A successful therapeutic approach to reduce the osteoporosis of many postmenopausal women would also illustrate this strategy, as would a drug to increase resistance to ionizing radiation in civilian or military experience. (Vaccines, such as those for polio, yellow fever, and smallpox, are analogous strategies in the closely parallel set to reduce losses from infectious agents.)

The *ninth* strategy in loss reduction applies to the damage not prevented by measures under the eight preceding—to move rapidly in detection and evaluation of damage that has occurred or is occurring, and to counter its continuation and extension. The generation of a signal that response is required; the signal's transfer, receipt, and evaluation; the decision and follow-through, are all elements here—whether the issue be an urban fire or wounds on the battlefield or highway. Sprinkler and other suppressor responses, firedoors, MAYDAY and SOS calls, fire alarms, emergency medical care, emergency transport, and related tactics all illustrate this countermeasure strategy. (Such tactics have close parallels in many earlier stages of the sequence discussed here, as, for example, storm and tsunami warnings.)

The *tenth* strategy encompasses all the measures between the emergency period following the damaging energy exchange and the final stabilization of the process after appropriate intermediate and long-term reparative and rehabilitative measures. These may involve return to the pre-event status or stabilization in structurally or functionally altered states.

Separation of Loss Reduction and Causation

There are, of course, many real-world variations on the main theme. These include those unique to each particular form of energy and those determined by the geometry and other characteristics of the energy's path and the point or area and characteristics of the structure on which it impinges—whether a BB hits the forehead or the center of the cornea.

One point, however, is of overriding importance: subject to qualifications as noted subsequently, there is no logical reason why the rank order (or priority) of loss-reduction countermeasures generally considered must parallel the sequence, or rank order, of causes contributing to the result of damaged people or property. One can eliminate losses in broken teacups by packaging them properly (the *sixth* strategy), even though they be placed in motion in the hands of the postal service, vibrated, dropped, piled on, or otherwise abused. Similarly, a vehicle crash, per se, need necessitate no injury, nor a hurricane housing damage.

Failure to understand this point in the context of measures to reduce highway losses underlies the common statement: "If it's the driver, why talk about the vehicle." This confuses the rank or sequence of causes, on the one hand, with that of loss-reduction countermeasures—in this case "crash packaging"—on the other.

There are, nonetheless, practical limits in physics, biology, and strategy potentials. One final limit is operative at the boundary between the objectives of the eighth and ninth strategies. Once appreciable injury to man or to other living structure occurs, *complete* elimination of undesirable end results is often impossible, though appreciable reduction is commonly achievable. (This is often also true for inanimate structures, for example, teacups.) When lethal damage has occurred, the subsequent strategies, except as far as the strictly secondary salvage of parts is concerned, have no application.

There is another fundamental constraint. Generally speaking, the larger the amounts of energy involved in relation to the resistance to damage of the structures at risk, the earlier in the countermeasure sequence must the strategy lie. In the ultimate case, that of a potential energy release of proportions that could not be countered to any satisfactory extent by any known means, the prevention of marshalling or of release, or both, becomes the only approach available. Furthermore, in such an ultimate case, if there is a finite probability of release, prevention of marshalling (and dismantling of stockpiles of energy already marshalled) becomes the only, and essential, strategy to assure that the undesirable end result cannot occur.

For Each Strategy an Analogous Opposite

Although the concern here is the reduction of damage produced by energy transfer, it is noteworthy that to each strategy there is an opposite focused on increasing damage. The latter are most commonly seen in collective and individual violence—as in war, homicide, and arson. Various of them are also seen in manufacturing, mining, machining, hunting, and some medical and other activities in which structural damage often of a very specific nature is sought. (A medical illustration would be the destruction of the anterior pituitary with a beam of ionizing radiation as a measure to eliminate pathologic hyperactivity.) For example, a maker of motor

vehicles or of aircraft landing-gear struts—a product predictably subject to energy insults—could make his product more delicate, both to increase labor and sales of parts and materials, and to shorten its average useful life by decreasing the age at which commonplace amounts of damage increasingly exceed in cost the depreciating value of the product in use. The manufacturer might also design for difficulty of repair by using complex exterior sheet metal surfaces, making components difficult to get at, and other means.

The type of categorization outlined here is similar to those useful for dealing systematically with other environmental problems and their ecology. In brief illustration, various species of toxic and environment-damaging atoms (such as lead), molecules (e.g. DDT), and mixtures (garbage and some air pollutants, among others) are marshalled, go through series of physical states and situations, interact with structures and systems of various characteristics, and produce damage in sequences leading to the final, stable results.

Similar comments can be made concerning the ecology of some of the viral, unicellular, and metazoan organisms that attack animate and inanimate structures; their hosts; and the types and stages of damage they produce.*

Sufficient differences among systems often exist, however—for example, the ecology of the agents of many arthropod-borne diseases is quite complex, and the life cycles of organisms such as schistosomes require two or more different host species in sequence—to preclude at this time many generalizations useful across the breadth of all environmental hazards and their damaging interactions with other organisms and structures.

A Systematic Analysis of Options

It has not generally been customary for individuals and organizations that influence, or are influenced by, damage due to harmful transfers of energy to analyze systematically their options for loss reduction, the mix of strategies and tactics they might employ, and their cost. Yet, it is entirely feasible and not especially difficult to do so, although specific supporting data are still often lacking. In fact, unless such systematic analysis is done routinely and well, it is generally impossible to maximize the pay-offs both of loss-reduction planning and of resource allocations.

Such analysis is also needed to consider properly the problems inherent in the use of given strategies in specific situations. Different strategies to accomplish the same end commonly have different requirements; in kinds and numbers of people, in material resources, in capital investments, and in public and professional education, among others. In the case of some damage-reduction problems, particular strategies may require political and legislative action more than others. And, where the potential or actual hazard exists across national boundaries, correspondingly international action is commonly essential.

The types of concepts outlined in this note are basic to dealing with important aspects of the quality of life, and all of the professions concerned with the environment and with the public health need to understand and apply the principles involved—and not in the haphazard, spotty, and poorly conceptualized fashion now virtually universal. It is the purpose of this brief note to introduce the pathway along which this can be achieved.

Suggested Readings

W. Haddon, Jr., "Why the Issue Is Loss Reduction Rather Than *Only* Crash Prevention," presented at the Automotive Engineering Congress, S.A.E., Detroit, Michigan, January 12, 1970, S.A.E. Preprint 700196.

W. Haddon, Jr., "The Changing Approach to the Epidemiology, Prevention, and Amelioration of Trauma: the Transition to Approaches Etiologically Rather Than Descriptively Based," *American Journal of Public Health,* 58 1431-1438, 1968.

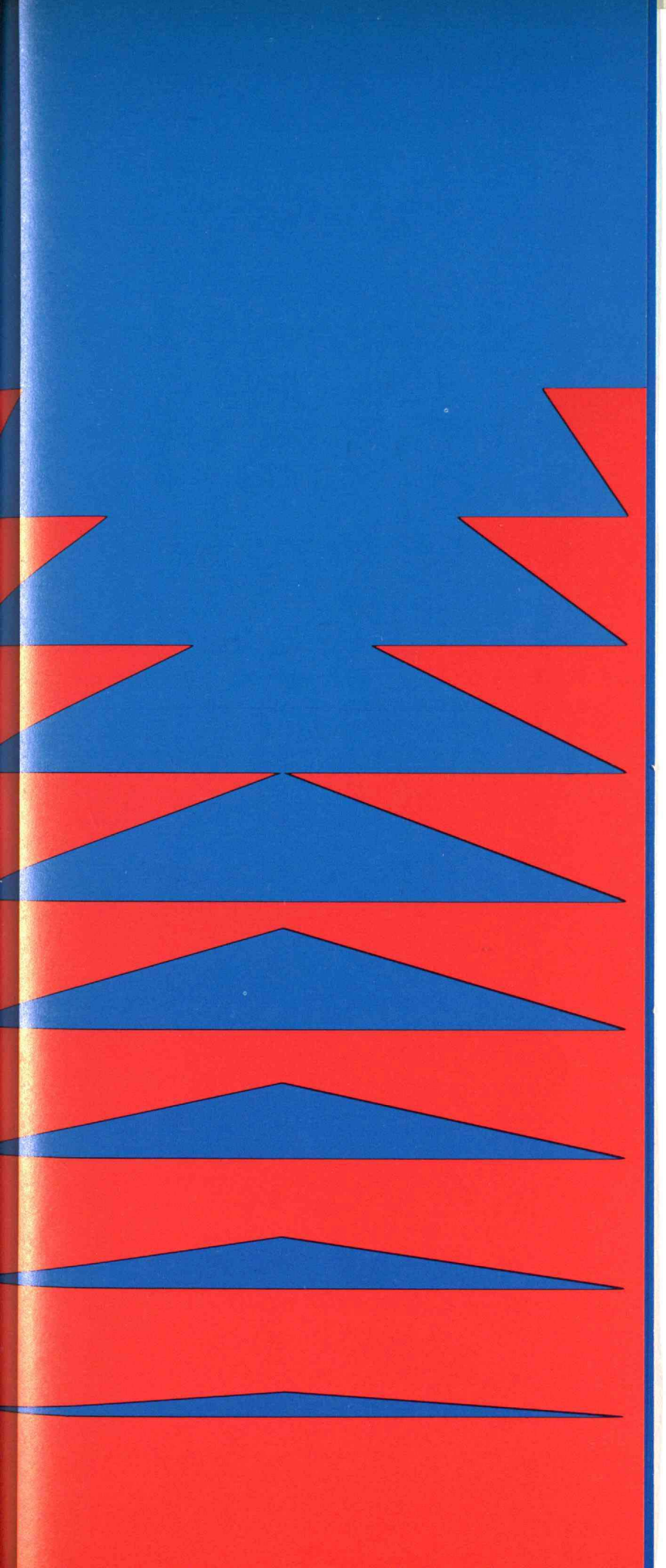
W. Haddon, Jr., "The Prevention of Accidents," in *Textbook of Preventive Medicine,* ed. D. W. Clark and B. MacMahon (Boston: Little, Brown, and Company), pp. 591-621.

W. Haddon, Jr., E. A. Suchman, and D. Klein, *Accident Research, Methods and Approaches,* Harper and Row, 1964. (See especially Chapters 9 and 10).

*Actual and potential birth control and related strategies and tactics can be somewhat similarly categorized. Thus, in brief, beginning on the male line: preventing the marshalling of viable sperm (by castration or certain pharmacological agents); reducing the amount of sperm produced; preventing the release of semen (or of one of its necessary components, e.g. by vasectomy); modifying the rate or spatial distribution of release of semen (as in hypospadias, a usually developmental or traumatic condition in which the urethra opens on the underside of the penis, sometimes near its base); separating semen release in space or time from the susceptible ovum (e.g., continence, limiting intercourse to presumably nonfertile periods, coitus interruptus, and preventing a fertile ovum from being present when sperm arrive); separation by interposition of a material barrier (e.g. condoms, spermicidal creams, foams, jellies); increasing resistance of the ovum to penetration; making the ovum infertile, even if penetrated; prevention of implantation of the fertilized egg; abortion; and infanticide.

Dr. William Haddon, Jr. was appointed by President Lyndon B. Johnson in 1966 as the first Director of the National Highway Safety Bureau, a position in which he served until 1969. A medical ecologist, he was for nine years an executive of the New York State Department of Health, following study at M.I.T. (S.B.'49) and Harvard (M.D.'53, M.P.H.'57). As President of the Insurance Institute for Highway Safety, he is now concerned with bringing the leverage of accident and casualty insurance companies to bear on the broad issues involved in reducing highway losses in damaged people and property.

A. Dismantling nuclear bombs and preventing production.	A. I
B. Limiting nuclear bomb size and manufacture.	B. II
C. Total nuclear use-ban treaty.	C. III
D. Plastic surgery.	D. X
E. Making polo goal posts to yield on impact.	E. VII
F. Old tires on sides of tugs.	F. VI
G. Snuggling auto bumpers in sheet metal.	G. Opposite of V
H. Causing earthquakes by damming streams. (*See "The Modification of the Planet Earth by Man," by Gordon J. F. MacDonald,* Technology Review *for October/November, 1969)*	H. Opposite of I
I. Skin tanning in relation to subsequent sun exposure.	I. A naturally occurring illustration of VIII
J. Railroad under- and overpasses.	J. V
K. Parachutes.	K. IV
L. Fire alarms.	L. IX
M. Storm cellars in tornado areas.	M. V and VI
N. Seeding an established hurricane.	N. IV
O. Built-in automobile crash padding.	O. VII
P. Fallout shelters.	P. VI
Q. Sanding icy sidewalks.	Q. III
R. Aircraft carrier arresting gear.	R. IV
S. Keeping people out of dry woods.	S. III
T. Fire doors.	T. VI
U. Boiler safety valves.	U. IV
V. Opening volcanoes to achieve controlled release.	V. IV
W. Lubricating San Andreas Fault to cause a succession of *small* slippages. (*See MacDonald, noted in question H*)	W. IV
X. Aircraft landing and takeoff priorities.	X. V
Y. Spacesuits.	Y. A variety of VI
Z. Underground disposal of radioactive wastes.	Z. V and VI
AA. Skin grafts for burns.	AA. X
BB. Diver's decompression routine.	BB. IV
CC. Hanging padding in horse stalls.	CC. VI



A Game in Earnest

Each of the situations opposite can be classified under one (or more) of the ten damage-reduction strategies listed below, or its damage-increasing opposite. The reader should classify each before consulting the author's answers under this insert.

The Strategies

I. To prevent the initial marshalling of the form of energy.

II. To reduce the amount of energy marshalled.

III. To prevent the release of energy.

IV. To modify the rate or spatial distribution of release of energy from its source.

V. To separate in space or time the energy being released from the susceptible structure.

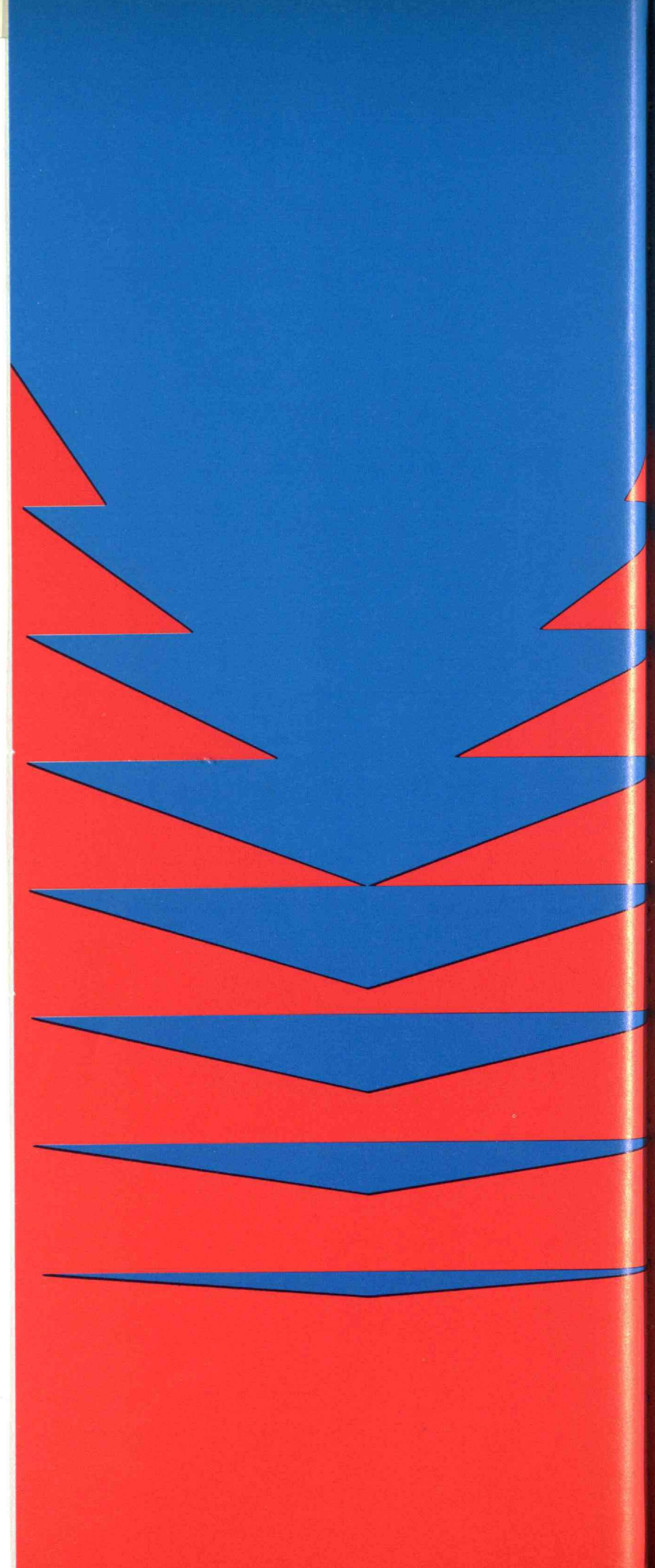
VI. To separate the energy being released from the susceptible structure by interposition of a material barrier.

VII. To modify the contact surface, subsurface, or basic structure which can be impacted.

VIII. To strengthen the living or nonliving structure which might be damaged by the energy transfer.

IX. To move rapidly in detection and evaluation of damage and to counter its continuation and extension.

X. All those measures which fall between the emergency period following the damaging energy exchange and the final stabilization of the process (including intermediate and long-term reparative and rehabilitative measures).



DD. Wrapping padding on goalpost supports.	DD. VI
EE. Window washers' belts.	EE. III
FF. Fire retardant clothing.	FF. IV
GG. Sunburn lotion that blocks U.V.	GG. VI
HH. Chaining tigers.	HH. III
II. Smoking in bed.	II. Opposite of III
JJ. Not moving flowerpots over onto windowsills.	JJ. III
KK. Stopping hemorrhage.	KK. IX
LL. Pointing a spear; edging a sword.	LL. Opposite of VII
MM. Banning explosives in tunnels or under "air rights" buildings.	MM. V
NN. Skiers' "pre-season conditioning."	NN. VIII
OO. Release bindings on skis.	OO. A variety of III, preventing *further* energy release.
PP. Mouth-to-mouth resuscitation.	PP. IX
QQ. Teaching Braille to a blinded soldier.	QQ. X
RR. Use of retaining walls to prevent California mud slides.	RR. III
SS. Fences around transformer stations.	SS. VI to achieve V
TT. Earmuffs.	TT. A variety of VI
UU. Reducing amount of explosive in each shipment.	UU. II
VV. The electrical fuse.	VV. A variety of III. It could be argued that the disconnection is usually achieved by V or VI (barrier, air), but whatever the physical means, the primary strategy is to prevent (further) release of energy.
WW. Playing with matches in pine woods.	WW. Opposite of III
XX. Welders' goggles and helmets.	XX. VI
YY. Fire fighters' suits.	YY. VI
ZZ. Fire escapes.	ZZ. V
AAA. Lengthening fuses on explosives.	AAA. V (to allow the lighter to avoid injury)
BBB. Roadside ("breakaway") poles that yield gently when hit.	BBB. VII
CCC. Lowering crib heights to reduce brain and other injuries when infants fall out.	CCC. II
DDD. Developing less expensive fender repair methods.	DDD. X
EEE. Preventing the conception of tigers to prevent subsequent human injury.	EEE. I

Filling an empty executive's office is a task of central importance. Above all technical qualifications, the author proposes a criterion which "relates to basic honesty with oneself and others and the psychological security to sustain, under pressure, concern for others while at the same time maintaining one's own position and convictions."

The qualities required of a leader cannot be judged by a computer, nor ever adequately measured by routine psychological tests or outside "experts"

Hrand Saxenian
Hrand Saxenian Associates

To Select a Leader

When we consider what a good leader is worth—in a factory, on a construction crew, in a research laboratory, executive office, city or ship—and what a poor leader costs—in money, accomplishment, material resources, human resources, human dignity—we see that the choice of a leader requires our best efforts, our most careful attention. So how should we set about finding and encouraging leaders, in all realms, who will wisely influence the development and uses of science and technology—leaders at all levels who will permit the individual to retain his identity as a person in a world which is organized on an ever larger scale, and in which so many decisions are based on narrow considerations?

"Self-made" leaders emerge in response to many forces, irrational as well as rational. Ability and experience are necessary, but sheer aggressiveness counts for much, as do chance, politics, discrimination, and that grasp of circumstances we call opportunism. And perhaps it is true that sometimes, unexpectedly and unpredictably, the position makes the man.

But given the task of *selecting* a leader, we shall do well to stress what is rational and controllable. We begin, usually, by looking for "drive" and purpose, knowledge and experience. These are pretty much taken care of in the process of the individual finding his way through the routine machinery of a modern organization. An engineer, scientist, or architect expects of his supervisors and managers basic technical knowledge and mature technical judgment. Similar expectations are held of managers of financial institutions, art schools, and law firms. In all professions, the assessment of the technical competence and administrative skills of managers and executives is generally given the careful attention it requires.

The Human Qualities

Professional competence alone, however, does not make a leader—does not insure that a person will command respect, get results, and point the direction in which his organization (people, constituency) must move. For this we must look beyond specialized competence to personal maturity. We must somehow discern the relative abilities of men and women of purpose to use their technical competence in new situations; to work under greater pressures than they have encountered in the past; to inspire and support the best efforts of others—starting with their immediate subordinates; to see themselves and their organizations as part of a larger changing scene, which can be constructively influenced.

These are among the qualities of personal maturity to be discerned in a potential leader. Throughout history they have been prerequisites for good statesmanship and executive leadership, and these qualities now become increasingly important—with the growth of scientific knowledge and the advance of technology—in those who would deploy the tremendous forces of man and nature.

These same qualities are now imperative at *all* levels, if strong organizations and free societies are to hold together amidst serious challenges to established customs and institutions. They characterize equally the effective foreman, research director, corporation president, minister, police sergeant or chief, army sergeant or general, school principal or superintendent, town or city manager. These qualities must be demanded alike of each: the differences are in the professional aptitudes and qualifications only.

These are human qualities, to be discerned by human beings—preferably, those most directly involved. They cannot be judged by a computer, nor ever adequately by routine psychological tests or outside "experts." They are best judged within the context of the situation in which the leader must work, by those most directly responsible for the selection and for its consequences. For the difference that a person will make to a new situation will result from the organic interaction between himself and that situation. For example, the same person will perform differently under a different boss.

A "good" selection made by an outsider is never as good as the same selection made by the person directly in charge of the position being filled. Although this immediate boss might well be overruled by his senior on a given candidate, the final selection decision should still be his—just as his own appointment should have been the responsibility of *his* direct senior.

Since the discernment of maturity is largely a matter of judgment, and since our judgment is hardly infallible, it is well to bring the separate judgments of at least a few concerned people to bear on the decision. When done with care, this brings a useful degree of objectivity to an

Interview impressions of

MANAGERIAL QUALIFICATIONS

(to supplement information on technical qualifications and record of performance)

NAME _____

✓ Individual impression
☐ Group impression

	low	below average	above	high
PHYSICAL IMPRESSION Appearance, bearing and manner.	____	____ ____	____	____
QUALITY OF RESPONSES Logic, judgment, clarity of thinking and expression.	____	____ ____	____	____
READINESS FOR MANAGERIAL RESPONSIBILITIES As evidenced by extent of expression of own feelings and convictions, with consideration for the thoughts and feelings of others.	____	____ ____	____	____
MANAGERIAL POTENTIAL Above factors combined, plus evidence of motivation and ability to increase his effectiveness with further experience.	____	____ ____	____	____

COMMENTS _____

_____

_____

_____

INTERVIEWER _____

DATE _____

The Interview Impressions Form is designed to focus attention on the three basic questions underlying any careful final interview:
—Does the candidate seem to make good sense intellectually?
—Does he seem emotionally ready for the pressures and responsibilities of the position to be filled?
—What seems to be his motivation for the position and his future potential?
Each of these questions still entails subjective judgments, and there is no prescribed weighting of them. But at the point of decision—after screening on the basis of background, qualifications, and past performance—there seems to be no substitute for carefully considered individual and group judgments on these three factors by those who must live with the decision.

inherently subjective matter. A procedure designed for just this purpose is presented here.

The "Expression" Criterion

At the heart of this procedure is a fundamental guideline, which I have been investigating since 1952, to assist individual judgment in the assessment of a person's maturity:

"The current level of a man's maturity is indicated by the extent to which he expresses his own feelings and convictions with consideration for the thoughts and feelings of others."

Forthrightness, combined with awareness of and consideration for others, is essential for communicating and working with others as a leader. And increasingly, though often in too facile a way, we hear of the need for openness, sensitivity, trust. Let us consider this particular articulation and its potential usefulness.

At first, this criterion for maturity appears to many to be obvious, or oversimplified, or erroneous, or just another value judgment. On consideration, however, it usually takes on fuller and more definite meaning: it refers to a quality of expression beyond mere articulateness or tactfulness. It relates to basic honesty with oneself and others, and the psychological security to sustain, under pressure, concern for others, while at the same time maintaining one's own position and convictions.

Originally an attempt to formulate something that, from my early selection experiences during World War II and in industry, I felt to be an intuitive perception shared and unconsciously exercised by most people, this proposed criterion for maturity has since shown both a pragmatic and a theoretical validity. Most people who consider it find that it reflects their experiences with the people they have known and worked with over the years. In use, as a conscious guideline, they find that it serves to heighten their awareness of what to look for in a potential leader, sharpening their perception of how well a person might handle new responsibilities.

This criterion is also supported by a small but growing body of basic research. In controlled tests of its validity, primarily among industrial, school, and police supervisors and administrators, composite judgments based on it (with the abstract word "maturity" removed) have correlated highly with independent measures of "effectiveness," defined as "how effectively one works alone and with others while under pressure in a variety of circumstances."

The reader can informally test for himself the correlation between the "expression" criterion and "effectiveness," by ordering his impressions of the qualities, performances, and lives of a few acquaintances and colleagues. Tests relating the criterion to personal effectiveness have been made in two ways. First, by noting how a person compares with others whose roles, authority, and responsibilities are similar to his, and second, by noting how his effectiveness has changed, for the better or the worse, over the years. These two ways of considering effective leadership would appear to include all practical cases in which we need and use a concept of human development such as "maturity."

The research to date suggests that "the extent to which one expresses his own feelings and convictions with consideration for the thoughts and feelings of others" is not simply one of any number of attributes of importance, but is by itself a key indicator of one's overall effectiveness. Besides proving useful in the selection process, this criterion has also helped in considering the whole question of positive leadership, including its early recognition and the establishment of management procedures which will encourage and facilitate its development. It accommodates wide diversity in individual personalities and styles of leadership and allows each person to make the most of his own natural style. There is an analogy here with learning a sport such as tennis, which seems to merit a brief digression.

In many sports there is a relationship between force and control which parallels the relationship in real life between self-expression and consideration for others. In tennis, for example, a player's game does not depend solely on how often or how hard he hits the ball, regardless of where it goes, nor conversely on his control alone. Nor is improving his game a matter of simply increasing one at the expense of the other. Force and control go hand in hand, increasing together with experience and stiffer opposition—alternating at times in their progress, but still rising together in the long run.

Expressing our true selves, and considering the thoughts and feelings of others, go hand in hand in a

The criterion for leadership described by Mr. Saxenian on the previous pages has been tested in relation to the perceived and measured effectiveness of executives by the techniques outlined on these pages.

Testing the Criterion of Maturity

Underlying the research on the validity of the criterion for maturity discussed here is the following hypothesis:

Expression, the extent to which a person expresses his own feelings and convictions, with consideration for the thoughts and feelings of others, indicates *effectiveness*, how effectively he works alone and with others while under pressure.

To permit operational testing, this has been resolved into two more specific forms:

Hypothesis 1:
Increases or decreases over periods of years in a person's *effectiveness* are accompanied by respective increases or decreases in his *expression.*

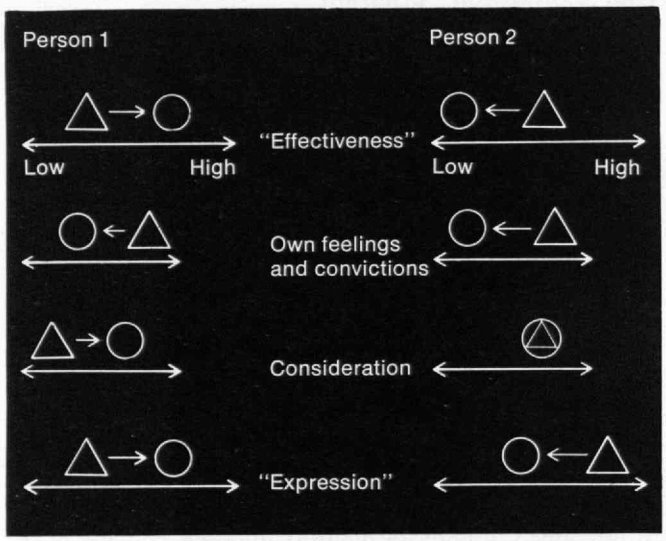
Hypothesis 2:
The relative *effectiveness* of people with similar activities and responsibilities corresponds to the relative level of their *expression.*

To obtain a feeling for how these two hypotheses can be tested, consider the following two sets of procedures.

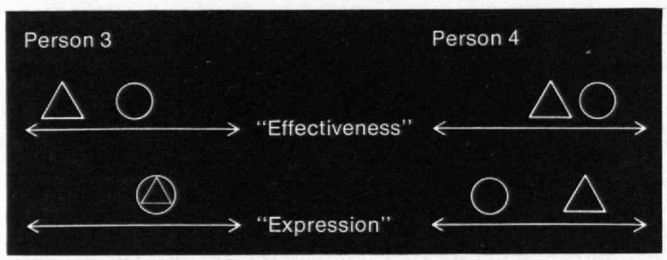
Testing Hypothesis 1
To test hypothesis 1 informally, recall a few people you have known reasonably well whose effectiveness or expression changed in your opinion over a period of years. They may be acquaintances of any age, from any walk of life. In each case, ask yourself if *both* effectiveness and expression changed in the same direction, for the better or the worse, over the period considered. If so, hypothesis 1 is supported by this case; if not, hypothesis 1 is refuted by this case. (*Reasons* for the changes may be of interest and importance, but are incidental to the question here of the general validity of the hypothesis. Also, the *magnitudes* of the changes are not of direct relevance here, only the *directions* of the changes.)

Each case supporting or not supporting the hypothesis can be depicted as at the right.

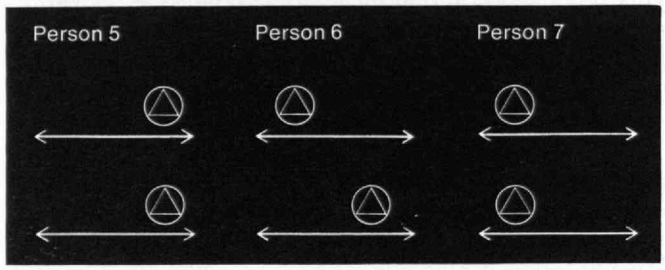
Hypothesis 1 supported



Hypothesis 1 refuted

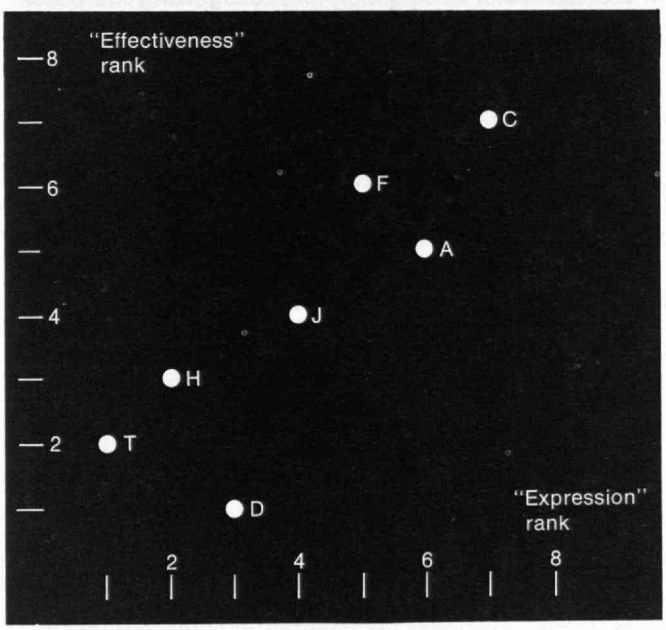


No evidence for or against Hypothesis 1



Testing Hypothesis 2
To test hypothesis 2 informally, call to mind a few groups of people you have known reasonably well with *similar* roles and responsibilities—supervisors, managers, military officers, teachers, classmates, etc. For each such group, rank its members against each other on their effectiveness and then on their expression. The following is an example:

Effectiveness ranking	Expression ranking
1. Dick	1. Tom
2. Tom	2. Harry
3. Harry	3. Dick
4. Jim	4. Jim
5. Allan	5. Frank
6. Frank	6. Allan
7. Cary	7. Cary
8.	8.
9.	9.



Visual comparison of the two ranking scales, or inspection of the pattern of points on the correlation chart, will give a rough indication of the extent to which any given group does, or does not, support hypothesis 2.

Rigorous testing requires two separate sets of observers, many subjects, many tests, control groups, and conventional methods of statistical analysis. The above basic processes and modes of interpretation remain the same though, whatever more refined techniques may be used for rigorous testing of the two hypotheses.

This approach is quite general, and can be used to test and compare alternative proposed criteria for personal effectiveness. Thus we can conceive of a competition of ideas—in quest of the best possible articulation, the most valid, understandable, and useful criterion for overall personal effectiveness. Together with historical and biographical evidence, this approach might help us to understand better in a fundamental way the more complex concepts—the higher level abstractions—of maturity and leadership.

similar way. Only as we learn to express ourselves more honestly and clearly are we able under increasingly demanding circumstances to remain considerate of others. Analogies are provided also by quite different sports, such as boxing and swimming. Force and control must be coordinated, and must improve together.

To extend the analogy: players have different styles and strategies, but we can appraise any player's game as a combination of force and control. Similarly a single criterion for maturity, or overall personal effectiveness, can be applied to each of us despite differences between our individual styles and temperaments. Life is more complex than tennis, but how each of us lives his life depends on how he uses (or is permitted to use) the particular temperament he was born with—as a tennis player's game depends on how he uses his particular playing style.

A Guide, Not a Measure

The "expression" criterion has been incorporated into the selection and promotional procedures of a growing number of organizations. In most cases it is used without any recorded ratings, but simply as a conscious guideline. Never easy to use, nor ever a substitute for thought, when used consciously it adds depth to what one looks for, and induces more careful thought about what one observes. The very awareness of the criterion is helpful to many people entering into a selection situation as interviewers.

On a more structured basis, and in particular to meet the needs of larger organizations, this criterion for maturity is being used explicitly as an indicator of *readiness for responsibility.* The Interview Impressions Form shown here—a simple tool in itself—is used according to a carefully worked out set of procedures, some key points from which follow:

1. Final candidates for appointment should be interviewed by three to four managers or supervisors, preferably from one level above the position to be filled, and including the responsible manager who should make the final selection.

2. Interviews should preferably be conducted separately by each interviewer. . .

4. Each interviewer completes his form after the interview and prior to any discussion of the candidate.

5. The interviewers together discuss the candidate and their individual impressions of each factor on the form, arriving if possible at an agreed-upon rating for each factor. . .

6. Next each interviewer makes any final comment he wishes, or indicates any final difference of opinion he may have with the group ratings, signs his form, and turns it over to the responsible manager, who combines this information with all other relevant information and arrives at his decision.

7. Once the decision is made, this form should be destroyed by the responsible manager. It has served its purpose as a working tool. Each new selection, promotion or transfer is best approached anew, encouraging a broad base of competition and recognizing the possibility of significant changes in a person's current readiness for managerial responsibilities.

This process, designed for use at the *final* stages of selection, places the responsibility for selecting the management team clearly within the ranks of the existing team, and does it in such a way that each immediate supervisor, manager, or executive selects his own man, yet with the benefit of the perceptions of others at his level of the organization. (Though elementary in concept, seldom are these steps practiced consistently and together. The total time required to interview and discuss, say, three or four final candidates may seem great, but it is really minimal in terms of the future implications for those directly involved and for the total organization.)

Keep It Practical

The interviews need not be highly personal, but rather practical. Each member of the management team learns with practice (without elaborate rules or instructions) to exercise his own best judgment in each case on what questions to ask, how to ask them, and how to listen to the responses. The required exchange of opinions helps him to refine his own interviewing approach. (The one strategy I would recommend is to give the candidate a full opportunity at the outset to say what is important to him and what he has to offer if selected, and then to question him for consistency with his own philosophy.)

When, as is not infrequently the case, the man selected

is the one who would have been chosen without this process, he and his new boss are nevertheless better off for having gone through the steps recommended here—as also are the other final candidates and managers participating in the decision. Often, when this process is used, some candidates are seriously considered who otherwise would not have been considered even at the outset. The increased opportunity for, and equity of, such consideration increases the chance of choosing correctly. The beneficial effects on performance and morale reach right down through the ranks of the management organization to the labor and nonsupervisory personnel.

While encouraging promotion from within, this same process is very helpful when a new manager or executive must come from outside the organization. Potentially unwise selections are guarded against, and a useful introduction to each other is provided the new man and the interviewing managers from a number of different departments.

The president of one large public utility company said of this selection process, "It irons out some of the tougher problems we have struggled with for a long time. We find it a practical way to broaden the base of competition for management positions. . . it increases incentive for effective management and for providing the best possible service to our customers." An initially skeptical senior police administrator and former Marine officer, with years of experience in the selection and promotion of men, said after his extensive participation in the underlying research, "This criterion gets at the heart of what all review boards look for when trying to size up the whole man." Many teams of interviewers have found that the continued use of the "expression" criterion leads to fuller concurrence of their separate impressions of candidates and to more accurate predictions of actual performance. And a number of them have expressed the opinion that this regular use of the criterion has constructively influenced their own management of men.

In a recent issue of *Technology Review, July/August 1969, p. 50)* John P. Eberhard, former Director of the Institute for Applied Technology of the National Bureau of Standards, made an appeal for man-centered standards in our increasingly complex technological society: "What an infinite capacity the human has to be a part of the process of measurement, and how little our standards attempt to use this ability!" In this spirit, whether used formally or informally, this criterion for maturity can help us to make the most of the rational possibilities open to us when we would select a leader.

Hrand Saxenian is a graduate both of M.I.T. (S.B., '47) and Harvard Business School (M.B.A., '49). Prior to forming his own firm of management consultants in 1961, he worked on applications of digital computers and operations research to military and industrial problems, taught management control at Harvard Business School, managed technical and project groups at Itek and Raytheon, and was Vice-President and General Manager of the Econometric Institute in New York. He is currently working with—among other clients—the New England School Development Council and with the Massachusetts Chiefs of Police Association on various aspects of communications, training, and control.

Trend of Affairs

New Ways of Building

One of the more convincing spin-offs from the space business is Harold B. Finger, the first man to hold the post of Assistant Secretary for Research and Technology within the Department of Housing and Urban Development. His background is in gas-turbine research and nuclear rocketry (he was at one time director of the N.A.S.A.-A.E.C. nuclear rocket program); about three years ago he took over Organization and Management within N.A.S.A., with the title of Associate Administrator.

When he first decided to work for H.U.D., he was asked by a N.A.S.A. colleague what his annual budget would be. Ten million dollars, was the answer—but why the question? How much money you need depends on how well defined your program is. If we could have unlimited funds, there is a real question as to whether we could use them without negative consequences. Speaking at an M.I.T. Aeronautics and Astronautics seminar early this spring, Finger said that federal housing programs of the past have undoubtedly contributed to the problems of today, due to failure to foresee consequences.

Technology, according to Finger's definition, is *"the means* by which we provide material benefits to society." In his present field, he finds, research on hardware and construction methods is less important than research on where the new housing should be put, how it should be financed (here, in particular, he considers that previous federal methods have hastened urban decay and suburban sprawl), how incentives for maintenance can be provided, and how the nontechnical obstacles to innovation can be overcome (for an account of these obstacles, see J. Karl Justin's article, pp. 22-29).

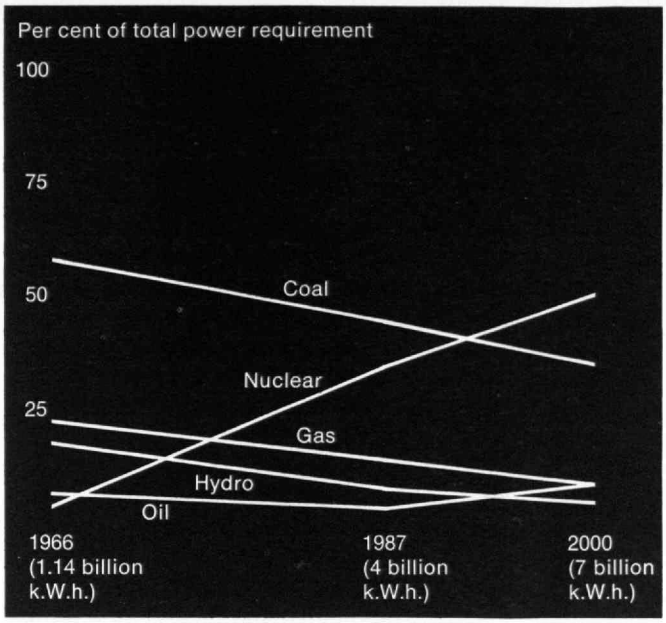
The migration from central cities leads to lower overall population densities in those cities. Without really careful planning, problems may arise in providing utilities, and services such as transport, to the diffuse residential areas of tomorrow. But the planner encounters the inflexibility of racial and economic segregation. In some of the ten areas that have been selected for Operation Breakthrough (an H.U.D.-subsidized trial of 22 systems of building) people want nobody poorer than themselves to live near them. "We're not prepared to ensure that," says Finger. Each test site, designed as a single entity, will feature a variety of types of housing and should provide local accommodation for a mix of people, including those who perform the more mundane functions within the community. Society as a whole must contribute to the task in hand.

The magnitude of this task is indicated by a few figures quoted by Finger. Congress estimated that, in the decade 1968-78, 26 million new dwellings would need to be built; in the previous decade, the number built was 15 million. There is also a qualitative discrepancy: the median price for today's new dwellings is $27,000; to pay this much at current interest rates requires a salary of around $14,000—which cuts out all but the top 20 per cent of the population. Builders naturally invest in the kind of housing that brings in the biggest return—not in the kind that the poorer half of the nation can afford.

So H.U.D. decided to give financial support to innovation in house-building methods. The closing date for proposed methods was September 19 last year. About five months later H.U.D. Secretary George Romney announced that 22 had been selected. Very soon, building should begin in 10 areas: in all, about 3,000 housing units will be constructed. H.U.D. will pay the difference between the total building costs (which includes that of design, testing, and development) and the proceeds of selling the products—a difference of around $60 million.

Finger seems optimistic concerning two of the main stumbling blocks: union objections to techniques that cut across the existing trade demarcations, and building codes which are addressed to specific hardware rather than to its performance. He reports that in the last year, unions have signed agreements permitting factory production methods to an extent that "you would not have believed a year ago." The tendency, he finds, is towards acceptance of the new techniques.

And the idea of an approval system based on performance testing of new materials, components, and techniques, which would override local code limitations, seems to be going ahead. Federal approval of such systems, according to Finger, will be based on performance specifications; testing will be done by the National Bureau of Standards and private testing laboratories using procedures evaluated by the National Academies of Science and Engineering.



No one need panic over the threat of pollution from America's increasing energy production, Philip Sporn, former President of the American Electric Power System, told an M.I.T. audience late this winter. The energy growth curve simply will not be as steep in the future as it has been in the past, he said, and more and more of our energy will be provided by relatively pollution-free nuclear sources.

Power Pollution—No Panic Proposed

The public utilities and the seers of doom are both wrong: man's thirst for power is not so great, or its by-products so poisonous, as to render Earth unfit for his habitation.

Philip Sporn, who as retired President of the American Electric Power System is one of the senior statesmen of U.S. power technology, told an M.I.T. seminar late this winter that growth is the "Achilles heel" of the public utilities' philosophy. It is true, he agreed, that U.S. power demand has doubled every decade in recent history; but for the U.S. electric industry—having reached a production of nearly 2 billion kWh. annually—that growth pattern simply cannot continue; "there are saturation factors," he said.

Mr. Sporn conceded that population growth is inevitable for the U.S., that economic growth must continue to support this growing population and to increase the quality of life, and that rising energy consumption is always associated with economic growth. But he insisted that increased energy production will not make the earth unfit for habitation. Such fears are simply unwarranted panic.

By the year 2000 nuclear power generation will provide half of the 7 billion kWh. which will be produced in the U.S., coal-fired generators 35 per cent; and this rapid increase in nuclear energy use will be a major factor in decreasing pollution problems.

It is clear, Mr. Sporn said, that from the standpoint of pollution, nuclear power is now far preferable to any other. Thermal pollution is slightly higher than in the most efficient conventional plants, but radiation is not a serious threat; a person living next to a modern nuclear generating plant receives an increment of radiation equal only to the increment received from natural sources by a neighbor who lives on a 400-foot-high hill.

The issues involved in disposal of the spent reactor by-products are well understood.

Why not, then, immediately specify that all new generating capacity in the U.S. be nuclear-powered? Because nuclear power is more expensive in many locations, because we have not the know-how and labor force to build new nuclear plants as rapidly as we need new generating capacity, and because we need more experience. Nuclear plants cannot yet begin to match the "several million megawatt years of experience" which lie behind conventional power generation, Mr. Sporn told his M.I.T. audience.

The Peripatetic Pest

Plants emigrate much as people do—by steamer across the ocean and by livestock across the plains. They, however, can be less than a blessing to their new homes. Of 540 weeds currently found in the United States, half are foreign; 13 of the 15 major pests are not native.

As in some areas of pest control, newer methods seek to modify the weed's environment in order to check its spread; the U.S. is now admitting a few new immigrants to keep the others in their places as they do at home. Their adaptation, like that of any new resident, has some success and some problems.

Alligatorweed, *Alternanthera phylloxerides,* is a visitor of some 70 years, a floating perennial which in 1963 infested about 97,000 acres of waterways in the Southeast. Herbicides killed only the more susceptible plant species, leaving a void for the aggressive weed. Mechanical removal was never complete, and regeneration was swift. Only a few insects seemed to feed on alligatorweed—in contrast to areas in its native South America where it is attacked by 40 different species. Its relative lack of abundance there suggested that insects might well control its spread.

A leaf-feeding beetle, *Agasicles* proved to eat only alligatorweed, and thus to be safe for other plants—the most essential virtue of an invited predator. In warm areas, *Agasicles* multiplies throughout the year, depositing its eggs on the leaves where they hatch and

feed. The larvae move inside the stems to pupate. 3000 beetles were imported and released at the Savannah Wildlife Refuge in South Carolina in the spring of 1964; a batch of 250 was released on the Ortega River in Florida the following spring. The Ortega River colony grew to hundreds of thousands and cleared the area of the weed in just over a year. The happy laborers were distributed through eight other states, and the beetle is now established in Florida, Georgia, Alabama, and Texas. In some areas it is rapidly successful; in others, such as the Savannah colony, it fails to prosper. The reasons are now under study. The quality of the water under the alligatorweed may influence *Agasicles'* increase; the nutritional quality and rate of renewal of the plant probably do.

One insect seems sufficient for alligatorweed; with other weeds, a more catholic thrust is necessary. *Lantana camara,* a range weed, entered Hawaii as an ornament, and rather overdecorated nearly 450,000 acres in diverse habitats. It was the object of one of the oldest attempts at biological control—23 different species of insects were brought from Mexico in 1902, of which 8 prospered, and by 1931 its spread was reasonably controlled. In the past two decades, insects have come from Kenya, Rhodesia, the Philippines, Florida, Cuba, and California to supplement the Mexican imports. *Teleonemia scrupulosa,* the strongest of the first batch, defoliated *Lantana* during the summer, but the plant recovered during the winter. Newer leaf-feeding lepidoptera are equally scrupulous during the cooler months, as are stem-boring cerambycids during the wet ones. Other insects feed upon the weed in other seasons and climates, and, through a complex orchestration, *Lantana* is now under control.

These two successes were discussed at the A.A.A.S. meeting last December by two California entomologists, Lloyd Andres and Richard Goeden. In their evaluation of the projects, they suggest that more specific study is needed of the physiology and biology of the weed itself and of its relationship to predator insects, to determine precise times and locations for attack. Restraining a weed's spread may be sufficient, and the most effective restraint is one which disrupts its use of energy and thereby lessens its ability to compete for space and food. Predators are now to some extent, and will be increasingly, chosen for their specific interruption of a weed's production, storage, or utilization of energy.

Things to Do With Trash

The Bureau of Solid Waste Management is a branch of the Department of Health, Education and Welfare which assists innovation in the disposal of solid wastes (other than from minerals and fossil fuel, which are the concern of the Department of the Interior). In recent months the Bureau has announced its support of a wide variety of experiments.

The city of Lynn, Mass., has received a demonstration grant of $51,550 towards a cooperative effort by the city and the General Electric Company. The idea is to check on the economics of burning municipal refuse as low-grade fuel. If it seems worth trying in practice, the industrial concern would provide "a steam-generating boiler that will incorporate air-pollution control devices," and the city would move and process the refuse and the residue from the boiler.

Incineration, of course, is not the whole answer to disposing of the mounting refuse load. Plastics present a particular difficulty. The toxic and corrosive gases that result from the incineration of common, everyday plastics are the subject of research headed by Professor Edward A. Boettner at the University of Michigan's School of Public Health. Most municipal incinerators are not adequately designed to burn plastics efficiently and safely, says Richard D. Vaughan, Director of the Bureau. So the Michigan team has been funded to discover quantitatively what are the undesirable gaseous emissions from each of the common plastics, and what are the best combustion conditions.

Gaseous by-products from the less modern solid wastes can be less of a problem, it would seem. Such wastes as paper, garden trimmings, and kitchen garbage—more or less natural organic materials—may become a source of methane. Dr. John T. Pfeffer, Associate Professor of Sanitary Engineering at the University of Illinois, believes that he has a fermentation process which will reduce the amount of organic waste to be disposed of by as much as 50 per cent (the remainder being in the form of "an innocuous humus," to quote, again, Mr. Vaughan). The U.S. domestic organic refuse output would produce methane equivalent to 4 trillion Btu. of heat, daily. Dr. Pfeffer's team is experimenting to discover the best conditions for fermentation.

Another technique utilizing microorganisms is being studied at Louisiana State University. Here, following the isolation of an organism that converts cellulose into a nutritious protein, the Bureau has subsidized the construction of a pilot plant, and further such organisms are being sought. The pilot plant can convert 250 lb. of sugar cane bagasse per day, producing 50 lb. of single-cell protein. The project's director, Dr. Clayton D. Callihan, hopes that it will handle other agricultural wastes, and newsprint. It is estimated that protein from this source should be economically competitive with soybean flour (14 cents a pound) and cheaper than protein derived from petroleum. The plant is located at

the National Aeronautics and Space Administration's Mississippi Test Facility.

The real drama remains with the municipal incinerators, however. An H.E.W. pamphlet authored by Mr. Vaughan last year makes particular reference to Combustion Power Unit-400, on which H.E.W. has now published a 17-page report (obtainable from Combustion Power Company, Inc., Palo Alto, Calif.). C.P.U.-400 will apparently take in the solid refuse of a town of 150-200,000, and generate 15 MW of electric power. It uses a high-pressure fluidized-bed combustor driving a gas turbine.

Nasal Decongestant Has Other Uses

"Discuss the role of . . ." Fit in the word prostaglandin, and you have one of the more intriguing and delightful questions in current medicine. The first prostaglandin (PG) was identified in human semen—hence its name—in 1935 by a Swedish scientist. Since then PG's have been found in many human tissues and in animals as far down the scale as marine coral.

Dr. U. S. von Euler 35 years ago reported his PG to have the "effects of lowering the blood pressure and stimulating various isolated smooth-muscle organs." Many of the effects since uncovered demonstrate this action on smooth muscle: the most recent, dramatic piece of research shows PG's to be successful in inducing abortion. They stimulate uterine tissue to contract—during labor, and perhaps after coitus to aid the movement of sperm—and they facilitate the contractions and thus ejaculation of the male organs.

PG's also control the dilation and constriction of blood vessels, and they may direct contractions of the lower intestine. They inhibit gastric secretion in humans and have been found to prevent ulcers in rats. It is suggested that they regulate fat metabolism in fatty tissues and that they help control water output of the kidneys; it is a renal PG which lowers blood pressure. Tests in guinea pigs suggest that PG's are superior to current bronchodilators for relieving breathing difficulties. And they may prove to be nasal decongestants of long duration. One paper reports finding PG's in 16 of 23 human tissues; they have been variously reported in the lung, brain, thymus, pancreas, kidney, and iris, as well as in the uterus and semen.

A righteous breadth of activities for one family of chemicals; and one suspects that many more will be uncovered, especially since the first chemical structures of PG's were determined only eight years ago and the first mass production techniques perfected two years later. At least 13 different PG's have been identified, related in that all are fatty acid derivatives based on the same 20-carbon-atom skeleton. They cannot conveniently be classed as hormones, co-enzymes, or transmitter substances, but they share with these groups the quality of being highly potent in minute amounts.

Very little is known about how they work. Evidence is not strong that they react with specific receptor sites in the cell, a favored explanation for many potent substances. They may somehow modify the actions of hormones or enzymes; another suggestion is that they facilitate the movement of calcium ions in the cell. Nor is there any clear understanding of their effects on the organ or tissue level. Part of this quandary arises because available analytical techniques can give only a stop-time picture of a moving process, imprecise at best, or leave the researcher to guess what happens in the reaction given the situation at either end of it.

Yet they do work. Two groups, from the Karolinska Institute and from Kings College Hospital, London, and Makerere University Medical School, Uganda, reported their results with PG in inducing abortion in the January 24 issue of *Lancet*. The Uganda-London group infused 15 pregnant women with 50 μg. of PG type F_2 per minute until abortion was complete (4 μg. of PG type F_2 per minute has been used to induce labor at term). Abortion was complete in 14; infusion was unsuccessful in one case (abortion was effected by other means). Diarrhea was observed in seven women and vomiting in three, probably because the prostaglandin also stimulated stomach and intestinal muscles.

The Swedish group used several doses by infusion and subcutaneous injection and reported 3 out of 11 pregnancies terminated. Both groups feel that solutions can be titrated individually to avoid nausea and diarrhea, and that the benefits of inducing abortion nonsurgically and later in pregnancy than is currently practiced may make this a useful technique. More research is necessary, of course, since these two samples are small.

Research is continuing—at the rate of 200 papers a year—and further knowledge of PG's and further therapeutic applications seem likely to come. The answer to the question of what their role is may turn out to be unusually long.

Mapping Venus Through the Clouds

Venus is at once our nearest and our most mysterious planetary neighbor, whose surface is perpetually concealed by clouds. But radar echoes from that planet now permit first primitive efforts to map its unseen surface, revealing altitude variations (near the equator, at least) considerably smaller than those of Earth, moon, or Mars, though its small-scale surface roughness is intermediate between that of the moon and of Mars. They also reveal that its shape is slightly elliptical and that its rotation is unique among all the planets.

Modern radar studies of the planets usually employ a variety of complex, intricate signal-coding and data-processing techniques, but the first hint of Venus's peculiar rotation came from a relatively simple observation: that the frequency spectrum of the echo signals showed very little of the broadening that would be produced by the Doppler effect if the planet were spinning at a reasonable rate under its veil of clouds. More sophisticated measurements show that the rotation period is almost exactly 243 days—a remarkably slow rate—and that the direction of rotation is retrograde—opposite to that of all the other planets.

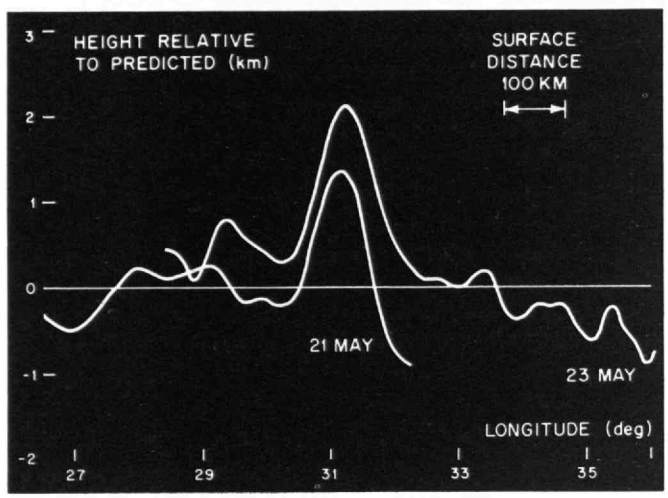
The motion of recognizable features on the planetary surface, mapped with interferometric radar techniques, strongly suggests that Venus always presents the same face to the earth at closest approach, as if its rotation had been "captured" by Earth's gravitational pull, but this question is still being hotly debated. Increasingly sophisticated measurements of time delay between transmitted and reflected radar signals suggest that Venus has a slightly elliptical shape with an offset center of mass, a fact that may help to explain its peculiar rotation.

The surface roughness of Venus can be inferred from back-scattering of the radar waves by irregularities comparable in size to the radar wavelengths. Such observations at wavelengths of 4 to 10 cm. suggest the roughness is intermediate between that observed for Mars and for the moon. Expressed statistically in terms of surface slopes (in this size range), Venus averages about 6° overall, while the moon comes closer to 10° and Mars—much "smoother" than either of these—only about 1°.

Localized variations of roughness can also be observed: repeatedly recognizable features are being located and verified to build up a "map" of the surface. Of particular interest are two features recently observed by interferometric measurements: large, circular, highly reflective ("rough") regions surrounding smoother, less reflective regions. The appearance of these regions on the radar map resembles that of lunar maria surrounded by mountainous highlands, but the radar "roughness" map does not show altitude variations per se, and the resemblance may be more apparent than real.

Indeed, the best measurements to date of altitude variations on Venus show its surface to be "flatter" than that of the moon and much flatter than Mars. These measurements have been limited to the vicinity of Venus' equator, and only about half of the circumference has been surveyed so far. In these areas, one elevated feature has recently been discovered which might be dubbed a "mountain range" by contrast with its surroundings, though it rises only about 2 km. above them.

The "mountain range" plotted below, derived from radar data, is the first ever detected on the surface of Venus. M.I.T. and Lincoln Laboratory scientists describe it as "well resolved" in longitude, where its extent is about 1.5° (150 km.) compared with the radar system's remarkable resolution of about 0.2°. Its north-south extent has not been definitely established. Radar observations of Venus suggest that the planet has very few such major surface features as this, at least in the equatorial regions that have been studied to date.

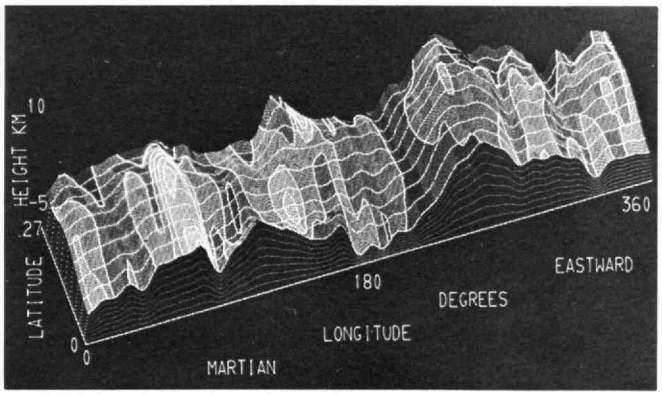


Similar studies of Mercury—which is a smaller planet, farther from Earth—suggest that it, too, is quite flat and has no broad-scale height variations greater than about 1 km.

Radar studies of Mars, by contrast, reveal altitude variations over a range of 14 km. all around its circumference in a strip extending from the equator to 27° north latitude. (The horizontal resolution for these measurements is about 300 km.)

The surface of Mars is visible, of course; light and dark areas have been well identified and named over the years by optical astronomers. These visible markings seem to be correlated with recent radar measurements: there is a tendency for bright visible markings to occur about 25° to the west of the highlands identified by radar, and the dark markings about 35° to the east. Somewhat surprisingly, perhaps, dark visible areas are generally bright and highly reflective to radar, but this apparent anomaly may simply be due to the chemical composition or the dimensional scale of surface roughness in these areas.

In contrast to Venus, radar reveals that Mars has much greater variations in altitude, covering a range of 14 km. The lowest measured point, just above the 180° mark, is 5.5 km. below the mean surface, the highest (directly above the word degrees) *is 8.0 km. above. Mars also shows many variations in surface texture. Visibly dark areas are generally bright and highly reflective at radar wavelengths; these areas tend to be located to the east of high-altitude regions, and visibly bright areas to the west. This three-dimensional computer display shows Martian topography, as measured by Lincoln Laboratory's Haystack radar, in a 27° strip north of the Martian equator; radar reflectivity contours are superimposed.*



The radar studies, sponsored by the U.S. Air Force and the National Aeronautics and Space Administration, were carried out at Lincoln Laboratory's Haystack Microwave Research Facility and Millstone Hill Radar; interferometric measurements used also the antenna at Lincoln's Westford Communications Terminal on Millstone Hill. The results have been reported in a number of papers by Michael E. Ash, John V. Evans, Richard P. Ingalls, Gordon H. Pettengill, Louis P. Rainville, Alan E. E. Rogers, and William B. Smith of the Lincoln Laboratory; and Charles C. Counselman, III, and Irwin I. Shapiro of the M.I.T. Department of Earth and Planetary Sciences.

Fourier Astronomy

While radar adds new dimensions to our knowledge of invisible planetary features (*see above*), a Stanford University graduate has begun work on a system for reinforcing visible-light planetary images which he hopes will yield "at least 10 times the resolution obtainable now."

William T. Rhodes, a doctoral candidate working under Joseph W. Goodman, Associate Professor of Electrical Engineering at Stanford University, proposes to obtain three images of a single planet simultaneously from a single telescope. He will mask out different portions of the aperture to make the single instrument produce three images, effectively, each with a severely limited field of view.

The three images will then differ only because they have been differentially distorted in their passage through three slightly different regions of the earth's atmosphere. Mr. Rhodes proposes to use a Fourier analysis computer program to detect and separate distortions, correlate the three images, and display a single corrected picture.

The theory of this system has been perfected and the masking device designed, and experimental work to determine more precisely the practical limits of the scheme is beginning. In theory at least, says Mr. Rhodes, it seems possible to design masks that could yield "as much as 10 times better resolution—if no other limiting factors appear." The limiting factor will probably be photographic grain noise.

Raman Spectroscopy —A '30s Revival

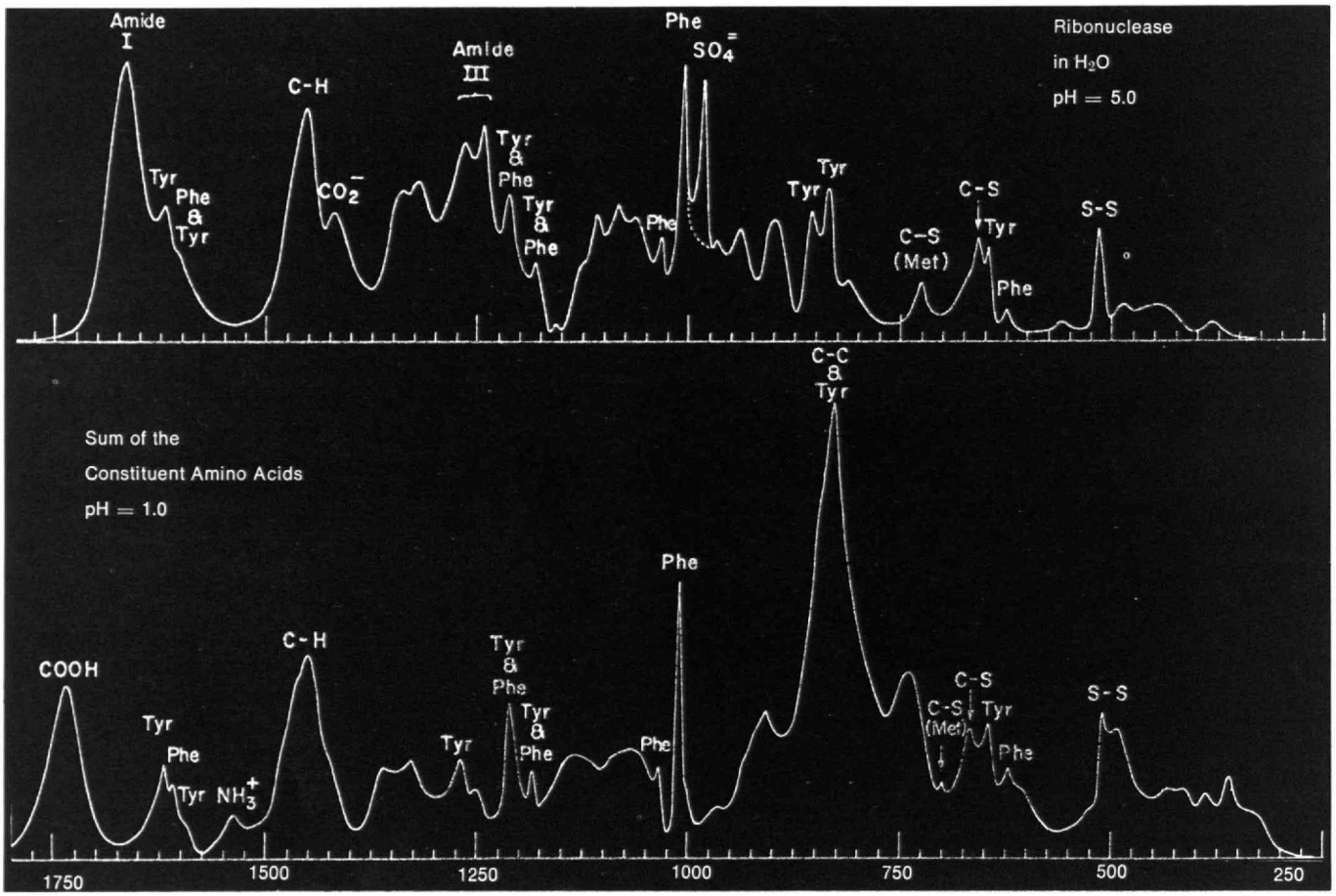
Recent years—specifically, the years of the laser—have produced what at first sight appears to be a new technique in spectroscopy, named for the Indian physicist C. V. Raman. The Raman Effect, upon which this technique relies, is a weak form of light scattering, in which the frequency of the light is increased or diminished by the exact frequency of one of the modes of vibration in the scattering molecule. Such vibration frequencies can also be observed directly by infrared spectroscopy; which technique is to be used depends on the circumstances, particularly the physical form of the sample.

Although it is generally known that Raman observed the phenomenon that now bears his name as long ago as 1928, it is not generally remembered that in the 1930s there was a burst of interest in Raman spectroscopy which today's activity closely parallels. It was early in that period that Professor Richard C. Lord, of M.I.T.'s Spectroscopy Laboratory, wrote his Ph.D. thesis—on the application of Raman spectroscopy to the study of molecular structures.

In a colloquium given by the Center for Materials Science and Engineering at M.I.T. this spring, Professor Lord recalled that thousands of papers were written on the chemical uses of Raman observations between 1930 and 1940. Recent Raman researchers have very often unwittingly rediscovered findings which are in this earlier literature. For example, Raman spectroscopy is now coming to be used for the study of proteins in aqueous solution (where most infrared radiation is "blacked out" by the water). This idea was suggested in 1938.

Because Raman scattering is weak, and because one needs to observe small frequency shifts with great accuracy, the advent of the laser, with its power and its closely defined wavelength, transformed a very tricky technique into a relatively simple one. The laser beam's tight collimation is a further advantage in the study of biochemicals, pure samples of which tend to be small. "If you wanted to tailor a light source for Raman work," said Professor Lord, "you would come up with something very like a laser."

The lower plot is the sum of the Raman spectra of the amino acids present in ribonuclease, with important bonds also marked. The scale is in wavenumbers, cm^{-1}. Above is the spectrum of ribonuclease itself. The SO_4 peak is due to an impurity but has been found useful as a calibration point in this work. (From a paper by Professor R. C. Lord and Dr. Nai-teng Yu, a research Fellow at M.I.T.)



The protein structures which have been worked out in recent years have in fact been the structures of these materials only in their crystalline state. Raman observation of the same molecules, and of their constituent groups, familiarizes the biochemist with another way of looking at a protein—a way that can still be used when it is in its more natural aqueous environment. It is possible, using Raman spectra, not only to count the disulfide links which bind loops of a protein chain together but also to measure how sharply bent they are, which is a clue to the geometrical shape of this link in the protein molecule. It should be possible to watch how an enzyme molecule behaves when it meets with the substrate whose reactions it catalyzes.

Biochemical Raman spectroscopy advances as researchers learn how to use this new kind of picture. "We think by analogy," said Professor Lord.

National Social Science Program

Universities are expected to supply much of the conceptualization for the National Science Foundation's comprehensive new program, "Interdisciplinary Research Relevant to Problems of Our Society." Dr. Joel A. Snow has been appointed Head of the I.R.R.P.O.S. office, according to a recent announcement from Dr. William D. McElroy, N.S.F. Director, and I.R.R.P.O.S. is awaiting research proposals.

Proposals submitted by university scientists—who may initiate projects either alone or in combination with industry, outside research groups, and nonscientific professionals—should be developed around the analysis

of a crucial societal issue. Although I.R.R.P.O.S. explicitly rules out social action enterprises per se, it does make clear that any satisfactory proposal will include a procedure designed to yield a range of techniques applicable to solution of the particular societal problem being treated.

While not discarding its own commitment to basic scientific research, N.S.F. recognizes by its $6 million funding of the interdisciplinary, social-goal-oriented I.R.R.P.O.S. that human problems cannot be examined in hermetically sealed compartments and that amelioration of society will depend on a wide sharing of varied professional data and insights.

Unitary planning, then, is to constitute the organizational principle for I.R.R.P.O.S. proposals. The rather suddenly revealed emergency need to improve life's environmental quality might represent such a central theme, and a brief consideration of this exemplary subject suggests how essential would be the involvement in the undertaking of people from the business community, lawyers, doctors, and other experts from outside the academic world.—*Mildred P. Cleaves.*

Lasers—Chemical, Military, Unfading . . .

In the laser business, the last few months seem to have been unusually productive. In December it was announced that a laser had been made which works on a purely chemical input. Fluorine gas and nitric oxide (NO) are mixed, and to the reaction products are added deuterium (or ordinary hydrogen) and carbon dioxide. No outside energy source is needed. A continuous laser output power of 8 W. has been recorded at a wavelength of 10.6 microns.

This work was done at Cornell University by Drs. Terrill A. Cool and Ronald R. Stephens. The chemistry of this laser is rather complex. Some of the fluorine is first reduced from molecules to single atoms (the other atom of the molecule combines with the NO); the fluorine atom combines with one atom of the hydrogen or deuterium molecule, and the resulting free atom of hydrogen or deuterium acts similarly upon the molecular fluorine left over from the initial reaction, producing more atomic fluorine. The end result of this chemical chain reaction is hydrogen fluoride (HF) or deuterium fluoride (DF) in an excited state (all these reactions generate energy). Finally, the fluoride passes its energy of excitation to the carbon dioxide which "lases."

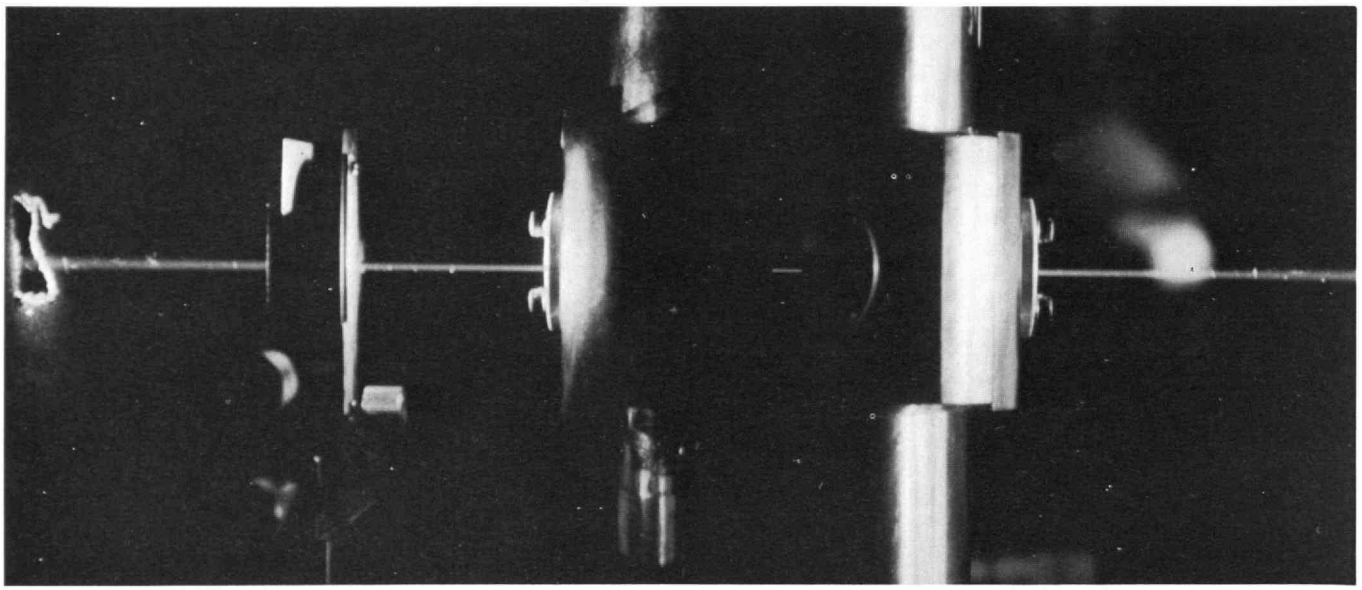
The efficiency reported so far is an impressive 4 per cent, but Dr. Cool hopes to raise it to 15 per cent. He describes this use of ordinary laboratory chemicals as opening "an entirely new dimension in laser technology" (*Chemical and Engineering News,* December 15, 1969, p. 58). More recently, in an appearance at M.I.T., Dr. Cool described his design for reaching powers of around 400 W. (continuous) with the same chemistry. The reagents would flow at right angles to the light path.

Although this work seems unconnected with weapons development, *Aviation Week* saw it as ground for hope that an old limitation on the military use of lasers might be removed (January 12, p. 17). In an article on "significant strides in technology using high-power continuous wave beams to destroy or disable targets thermally," *Aviation Week* points out that the trouble with the high-power gas laser as a weapon has been its need for a "pumping" system to excite the gas. Even so, the energy outputs of gas lasers have been rising—whatever the difficulty of putting the energy *into* them—and this alone has revived faith in the anti-aircraft or anti-missile ray-gun (which is, of course, authentic Buck Rogers, dating back to the late 1920's). There have been rumors that a continuous-wave gas laser generating hundreds of kilowatts has been made.

The Air Force requested $8 million for high-power laser research for fiscal 1970. Various weapon schemes have been suggested, but "the real payoff for the $50-100 million or more the services have already invested in laser weapons would come in ballistic missile defense, should it prove a realistic goal." Because a light beam travels rather faster than an antimissile, a battery of laser guns would even have time to sort out the warheads from the decoys—"a seemingly insurmountable difficulty for missile defense."

Meanwhile, the Air Force Cambridge Research Laboratories, Hanscom Field, Mass., announced a very simple finding which has little or nothing to do with death-rays and which should be of interest to ruby-laser users in all walks of life. Dr. C. Martin Stickley and others sought out the source of the color change that occurs in a ruby laser after it has been fired a few hundred thousand times. (The Air Force is interested in this because it limits the life of lasers used in ranging systems.) Dr. Stickley rejected many possible color-change mechanisms, including the currently accepted hypothesis, which concerns a change in the ionization state of the laser's chromium ions. He established that the changes actually occur mainly among residual impurities on the surface of the laser rod. Grinding half a millimeter off the end of the rod reconditions it almost completely. Alternatively, the efficient life of a ruby laser can be extended by filtering out the ultraviolet from the light used to pump the laser, for the color change is not caused by the laser's own output but by ultraviolet and visible blue light in the input.

A laser beam passing through a vessel of liquid helium is visible (through the central window) because light is scattered by phonons—quanta of vibration. The photons are seen to be about as visible as clean dry air. Dr. Thomas J. Greytak, however, is using the laser light to study rotons, which are another kind of quanta, 10,000 times less visible.



. . . and Mysterious

A remarkable new trick with light is reported by two physicists at the Rensselaer Polytechnic Institute's Hartford Graduate Center, Conn. H. Schwarz and H. Hora have succeeded in observing the electron diffraction pattern produced when an electron beam is shone through a crystalline specimen, without employing a fluorescent screen to reveal the electrons.

It is done by shining a laser beam through the specimen, at right angles to the electron beam; in some manner which is not yet understood, the electron beam picks up the light frequency, and re-emits it when the electrons hit a nonfluorescent alumina screen. What is observed is that light is given off from the screen at about the same frequency as that of the laser—and the only connection between the two is the electron beam. Lowering the electron energy and increasing the intensity seems to make no difference (whereas if a fluorescent screen is used this change causes a weakening of the fluorescence).

One other unusual feature of this research is that it was done on a state science budget—it was funded by a Connecticut Research Commission "Research Support Award." (*Applied Physics Letters,* Vol. 15, p .11).

Light on the Nature of the Roton

The photograph shows a light beam from an argon-ion laser passing through a dewar vessel of liquid helium. Through a small window in the dewar, the laser beam—which has a power of one watt and a wavelength in the green region—is seen also as it passes through the liquid itself. It is made visible by being scattered, not by the helium, but by quanta of vibration energy within it, known as phonons. As can be seen, the light-scattering power of the phonons is about the same as that of the clean, dry air outside the dewar: thus, only a powerful laser beam can render them visible at all.

Phonons are one of the forms in which energy exists in liquid helium below the so-called lambda-point (2.17°K.). In this temperature region, the liquid is called helium-II and is in a state known as superfluidity; all its energy is in quantum form. Phonons, which are similar to acoustic sound waves, are not peculiar to helium-II, but are present in all liquids and solids. However, since helium is in many ways the simplest of all liquids, the study of these phonons in their pure form seems likely to contribute to the understanding of more complex and more ordinary situations.

Another quantum form in which energy is found in helium-II is the roton, named because it looks in some ways like a vortex ring (a smoke ring, for example). Rotons are found only in superfluid helium and are involved in many of its strange properties. Whereas phonons are the basic form of energy in helium-II (they are easily produced since their energies are much smaller than the thermal energy), rotons are less abundant since their energy is much higher—of the order of 9°K. As the temperature of the helium-II is varied between, say, 1° and 2° K., the principal effect on the rotons is to make them more or less numerous.

In a painstaking series of experiments conducted about ten years ago, the relationship between the energies and the momenta of both phonons and rotons was measured by observing their neutron-scattering properties (neutrons of the right energy for interaction with these quanta also have about the right momentum—a circumstance which makes such an experiment practicable). The result was the energy-momentum curve shown here. Clearly, the roton is not a particle, for the energy of a particle is proportional to the square of its momentum, and the curve shows a quite different relationship.

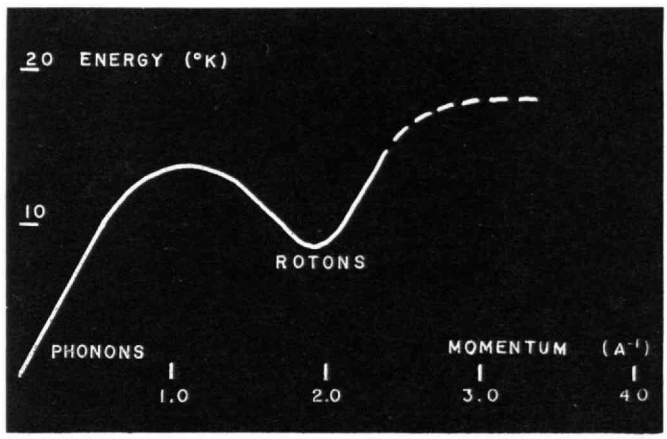
At M.I.T., Dr. Thomas J. Greytak, an Assistant Professor of Physics, has now succeeded in observing rotons with light. It is his apparatus that is shown in the photograph. Whereas the scattering of the light by phonons is clearly visible, the interaction that Dr. Greytak employs—between light and rotons—is 10,000 times weaker. It consists in the creation, by a photon of light, of a pair of rotons moving in opposite directions. In the process the photon undergoes an energy loss, which is small compared with the photon's total energy but which is nevertheless easily measurable as a wavelength shift. Light spectroscopy offers much greater sensitivity in measuring small energy changes than does neutron spectroscopy, and thus it is possible to measure the energy of a pair of rotons with new precision.

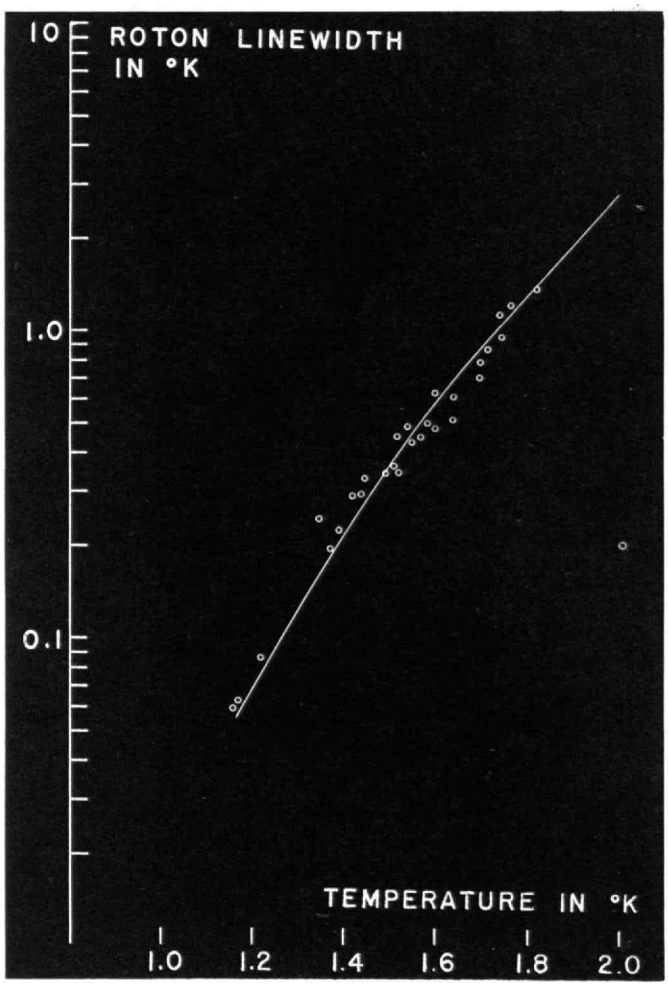
The reason for choosing the roton-pair-production phenomenon is that the photon's momentum is far too small to permit the sort of simple scattering experiment that can be done with neutrons; for momentum to be conserved in an observable interaction between photons and rotons, it is necessary for the rotons to occur in pairs, with opposed velocities, so that their momenta almost exactly cancel out.

At the annual meeting of the American Physical Society in Chicago this winter, Dr. Greytak reported that, as the temperature of the helium-II was raised (in the range 1-2° K.) the energies of the rotons became progressively less well defined—the "linewidth" increased, as shown in the second diagram. From basic quantum-mechanical principles, this implies that in colder helium the rotons have long lifetimes, and in warmer helium they are relatively short-lived.

This is to be expected. At higher temperatures, as mentioned above, the population of rotons is greater, and this reduces the time between collisions (assumed to be disruptive). This idea can be formulated mathematically,

Top diagram is a plot of energy versus momentum for the quanta found in superfluid liquid helium. Most of the quanta are either in the low-energy region (phonons), reflecting the actual temperature of the liquid, or are near the 8.65°K. minimum of the curve (rotons). The absence of any simple connection between energy and momentum indicates that the two kinds of quanta are different in nature. The energy of the rotons turns out to be well-defined only at low temperatures: at higher temperatures the energy "linewidth" increases as the density of rotons rises and collisions between them become more frequent. The curve of energy linewidth versus temperature provides evidence as to what kind of entity the roton is.





The Christian Science Monitor *and its Science Editor enjoyed a bit of mutual admiration when Robert C. Cowen received the Grady Award of the American Chemical Society in Houston early this spring. "The* Monitor *gives me a unique opportunity to do the best kind of science writing . . . a little more reflective and interpretive," said Mr. Cowen. Saville Davis, a long-time* Monitor *editor, returned the compliment in a letter to the A.C.S. in which he called Mr. Cowen "a reporter's reporter. Editors don't tell him what to do; he tells them. . . . His colleagues enviously look on and wish they knew enough more than their editors to play the same game."*

and does indeed give a linewidth-temperature curve which fits Dr. Greytak's observations.

Although simple quantum-thermodynamic theory dictates the shape of the linewidth curve (independent of what *sort* of entity a roton is) it does not dictate exactly where the curve will lie. This depends on the strength of the interaction between rotons—in other words, how near a pair of rotons must approach for a scattering "collision" to occur. Dr. Greytak's observations supply this missing information on roton interactions.

Previously, the roton was known only as a packet of energy with a certain momentum. We now know something of its mating behavior.

Electron Micromovies

One of the most appealing inventions of recent years is the scanning electron microscope (S.E.M.), which produces very solid-looking pictures of microscopic objects (hitherto observed only in the myopic fashion of conventional microscopes, with their inherently limited depth of focus). With the arrival of the S.E.M., microscopists were able to work with realistic views of complete structures which they formerly had to reconstruct plane by plane.

The S.E.M., under the trade name Stereoscan, was developed by Cambridge Scientific Instruments, Ltd. (Cambridge, England). The British National Physical Laboratory (Teddington, Middlesex) has taken micro-immediacy one stage further. It is now possible to take movies through the same instrument. The basic S.E.M. works by scanning a beam of electrons across the specimen and using the electrons that bounce off it as input to an amplifier, and thence to a cathode-ray tube, on which the picture is built up line by line. By improving the electron detection system and amplifier, N.P.L. workers have now speeded up the picture-generation process to the point at which successive views can be recorded on videotape as a movie. The system has been demonstrated as a way of continuously observing the changes taking place in materials under mechanical stress—in particular, materials such as carbon-fiber reinforced composites, whose deformation and breakdown are still only dimly understood.

"I Despise You!"

Science is in trouble with the public—in England, where he is now stationed, as well as in the U.S.—because of three misconceptions, says Robert C. Cowen, Science Editor of the *Christian Science Monitor:*

1. Science has been portrayed as the source of wealth, a set of disciplines with special power for those who are "out to make a buck."
2. Science and technology have been portrayed as omnipotent, but scientists are unaware of their image and their power.
3. Science and technology are seen as out of control, messing up the world without thought or conscience.

It was true 20 years ago, too, when the poet Robert Frost began a reading by telling his M.I.T. audience, which included Mr. Cowen, "I despise you!"

The science writer's duty, said Mr. Cowen upon receiving the James T. Grady Award of the American Chemical Society in Houston early this spring, is "to convey what science is all about, what technology means to people. Science writers and scientists alike," he said, "must bring down the barriers" between the professions and the public.

On Lead Pollution

Lead in the atmosphere of San Diego, Calif., has been increasing at the rate of 5 per cent a year during the several recent years when Tsaihwa J. Chow and his colleagues at the Scripps Institution of Oceanography have been taking careful samples. Downtown San Diego air now shows weekly average concentrations as high as 8 μg./cu. m. in the winter, Dr. Chow told the spring meeting of the American Chemical Society in Houston; the tentative national limit for lead is 10 μg./cu. m.

Dr. Chow and his associates have for three years operated five sampling stations in the San Diego area to represent its three different environments—downtown, seashore, and mountains. They have found levels of lead in the air increasing dramatically from mountains to seashore to city center. On the average, between 3.5 and 7 per cent of the suspended material in San Diego air is lead.

Studies of the lead isotopes involved convince Dr. Chow that a large proportion of the air-borne lead which he measures must be attributed only to automotive exhausts. And he cited studies by other workers who have found "excessive lead as high as 400 p.p.m. in soil and vegetation along roadsides."

The lead pollution first appearing in air and soils is undoubtedly gradually incorporated into plants and animals, Dr. Chow told the A.C.S. "Long-term increases in atmospheric lead result in predictably higher blood lead levels in the exposed populations," he said; "the health hazard of increasing lead pollutants in the environment cannot be ignored."

From Air into Water

Is air pollution a significant source of water pollution over Lake Michigan? The question is not flippant, the answer not rhetorical, to John W. Winchester and his associates at the Great Lakes Research Division of the University of Michigan. For water moves out of Lake Michigan only very slowly, and the supply of air pollution particulates carried by prevailing winds over the lake is abundant.

Hence Professor Winchester's continuing program to sample aerosols near Lake Michigan, in the waters of the lake itself, and in bottom sediments downwind of the principal industrial sources. He and his associates conclude that "unrestricted air pollution remains as a relatively large source of trace metals to the lake," he reported to the spring meeting of the American Chemical Society in Houston. The research program will continue, with efforts to make "refined" estimates of the strength of trace-element air pollution sources which may affect the lake, and of the actual fallout into the water.

The problem is especially important, Dr. Winchester said, because of the long residence time of dissolved substances in the lake—about 100 years—before outflow into Lake Huron. Since the reversal of Chicago River and Calumet River flow, 50 to 60 years ago, air pollution may be the largest source of trace metal pollution to the lake, apart from direct sewage outfall. Once polluted, flushing may take centuries to clarify the water and even longer—if ever—to cleanse the sediments.

Microbioegyptology

When it was discovered in 1922, the tomb of King Tutankhamen presented to the modern world a wealth of fabled treasures, and a fabled and occasionally effective curse. Now one inauspicious further relic, a bit of tissue dust, has attained importance by yielding an identification of the King's blood.

Substances of the ABH blood groups and of the MN antigen groups occur not only in red blood cells but throughout living tissue. Because of their chemical nature they are not easily broken down. They can be perceived in the remains of tissue at least as ancient as the mummies of Egypt and South America, some 3,300 years of age, and blood testing of such remains has become a standard procedure. However, this testing usually requires large amounts of tissue, and only a miniscule amount of King Tut was available. Researchers of the University of Liverpool therefore developed a microserological technique which used only 10 mg. of the King's remains: the dust is pulverized, and the blood group substances eluted by washing with Alsever's solution and centrifuging. Fresh human erythrocytes of type O were added to the supernatant solution and allowed to absorb the critical substances. These cells were then washed again and tested by normal agglutination procedures. The ABH and MN types could be determined; there is yet no evidence that Rh information is similarly recoverable.

King Tut was type A_2, MN.

The King's brother-in-law, Smenkhkare, was then tested, and confirmation of his blood type as A_2, MN adds to growing anthropometric evidence that the two men, both pharaohs and both sons-in-law of the great leader of the Eighteenth Dynasty, Akhenaten, were also brothers. A clearer definition of the relationship may present a redefinition of their history.

Nothing Stays Put

After 400 people struggled through a spring nor'easter and the air controllers' sick-in to reach the Eastern Regional Conference on the Application of Science and Technology to Public Programs at M.I.T., they didn't need to hear what Donald A. Schon told them:

"Over the last decade the U.S. has been guilty of a vast mismanagement of its intellectual resources." We have failed to use our energy to resolve "our incompetence to effect institutional change." As a result, said Mr. Schon, "we are now unable to do what we have committed ourselves to do"; we have not yet, for example, managed to improve conditions of housing, transportation, and health care.

Why?

Dr. Schon, who is President of the Organization for Social and Technical Innovation, Inc., offered four reasons for our troubles in coming to grips with our real problems:

1. Our problem-solving approach tends to assume that both the problem and the solution will be the same when we finish working on them as they were when we started. But everything is moving, nothing stays put. "If an idea is in good currency, it is probably no longer significant; and if a grant is made for work on such an idea, then it is for the wrong subject," he said.

2. We have simplistic ideas about how to work an experiment. We presume that all the variables which enter into a situation can be known and controlled while we manipulate the single factor whose effect we wish to study.

3. We assume that the results of a pilot study are valid when applied to the full-scale problem. But we do not really understand the effects of scale—or of the individuals whose presence may have been crucial to the success of the pilot model.

4. Our system—though it is constantly shifting and moving—in fact has considerable resistance to deliberate change—a "dynamic conservatism," Dr. Schon called it. "Every system has a technological plenum into which new technology must fit," he said.

Dr. Schon's suggestion: we must try to think about social-technological ventures as "learning systems, which must be capable of transforming themselves to meet changing conditions."

Probable Price Action of 1400 Stocks At-A-Glance ...Each Week Including Friday's Close

CSI Did Not Invent The Resistance And Support Theory... It Is Older Than Most Investors Living Today. However, CSI Devised A Manner Of Presenting Information That Is Easily And Quickly Read

There is nothing certain about the Stock Market — except that it will either go up or down. Therefore, the decisions to make all purchases and sales must be based on probabilities.

Resistance & Support is not the only factor that affects the stock market — but it is an important one.

To reveal this important phase of stock information to you at-a-glance, is the purpose of the CSI Resistance & Support Chart Book.

Resistance & Support Charts are based on **facts** — the price change history of each stock, updated by computer to Friday's close.

Only when a stock is in new low territory is the method changed. Even in this case, it is based on **facts** and history.

CSI'S RESISTANCE & SUPPORT THEORY

According to the dictionary:

Resistance is an opposing force.

Support is the act of keeping from falling.

In the Stock Market, as in most free markets, prices are controlled by supply (Resistance) and demand (Support).

In R & S Charts the comparative length of the lines **above** the current price indicates the relative **supply** or amount of stock available at that price.

If the lines are **below** the current price they indicate the relative **demand** or amount of stock that will be bought at that particular price.

If the stock is falling in price, it will continue to fall until it reaches a price at which there are enough buyers to create sufficient demand (Support) to halt its decline.

The reverse is true of a rising stock. It will continue to rise until it reaches a price at which a sufficient number of investors are willing to sell, creating supply (Resistance) to halt the upward movement.

WHAT CAUSES RESISTANCE AND SUPPORT?

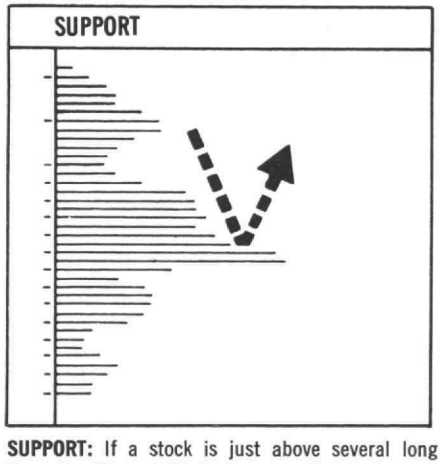
The Resistance and Support phenomena has been mentioned in practically every treatise and book written on the movements of stock prices. It has been accepted generally that Resistance and Support occur in "Areas of Congestion" (where in the past stock has been traded most often). Basically R & S Charts reveal these "Areas of Congestion."

A SIMPLE EXPLANATION OF R & S CHARTS

The "V" or "Λ" indicates the price at Friday's close and the direction of the most recent price move.

The length of the lines indicates the relative Support or Resistance.

RESISTANCE: If a stock is just under several long lines it will most likely fail to get through the long lines and the price will drop till it finds support.



SUPPORT: If a stock is just above several long lines it will most likely bounce off this Support and the price will rise to the next Resistance Zone.

SIMPLICITY

Don't be misled by the apparent simplicity of Resistance and Support Charts. Remember, they contain a mass of price information from the past years, up to Friday's close.

CHANGING PICTURES

Resistance and Support Charts are moving pictures, to help you keep pace with today's fast, changing markets. Although many R & S Charts contain data derived from the 1930's (which still affects present price action), the prime need for **speed** in updating and keeping each chart current is an integral factor in the R & S service.

After Friday's market close ... using the most modern technology, the new charts of the 1400 stocks are replotted by CSI's computers and the new, updated, current issue is in the mail to all subscribers no later than Saturday afternoon!

WHY WE DISREGARD VOLUME

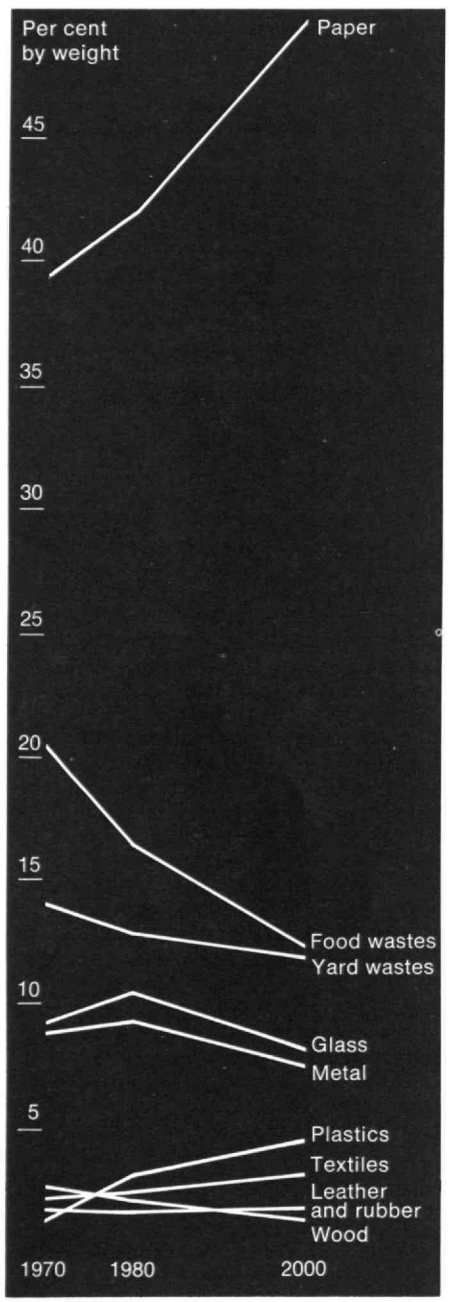
When we speak of volume, we are not referring to upticks and downticks, which are a separate study in themselves.

Some investors will act with a complete lack of emotion, while others will change with every bit of news. Consequently, the actual number of shares available at any particular price is **constantly changing.**

For this reason we disregard volume and concentrate on price action.

Chart Service Institute does not state or imply that any theory, formula or system will assure Stock Market success. To make money in the Stock Market requires study. The compilation of Resistance and Support Charts is a reference handbook to cut your study time.

It is not the policy of Chart Service Institute to recommend specific issues. Past success does not guarantee future performance.



Science for Public Programs: Too Little or Too Much?

So far, science and technology have made at best a handicapped start in the race to resolve our pressing urban and environmental problems. How they might stretch their pace was the subject of a two-day Eastern Regional Conference on Science and Technology for Public Programs which brought 400 people in government, industry, and education to M.I.T. this spring. The meeting exorcised their frustrations, raised some common problems, and plans to publish some recommendations—but—as to offering a new dynamic for these problems—it did very little, indeed.

A few speakers dared to strike an inspired tone. Keynoter Paul N. Ylvisakar, former Commissioner of the Department of Community Affairs of New Jersey, called for drastic changes in bureaucracy to "personalize" the "process of getting things done"; and Harold Finger, Assistant Secretary for Research and Technology, Department of Housing and Urban Development, confidently predicted the application to housing and city management of such space program principles as planning for unknowns, rigorous timetables, and managing a system in its totality.

But, compared to the optimism and confidence which lauded the entry of science and technology into the problems of space travel ten years ago, the Conference seemed cheerless indeed. The mood was not lightened by a handful of activist students explaining why youth doesn't believe more technology will make fewer social problems.

The frustrations appeared in a number of instances. In one workshop on education, the audience appeared visibly impatient with a presentation on a time-sharing computer-controlled educational television system which is still far too expensive for most overcrowded, financially starved U.S. schools. Instead, they applauded a student who argued that that part of education which teaches wonderment, argument, and original thought will never be taught by a machine anyway. In a workshop on housing, a Stirling Homex Corporation speaker described the coming of industrialized building only to discover his government audience interested mainly in *where* these millions of homes will be located.

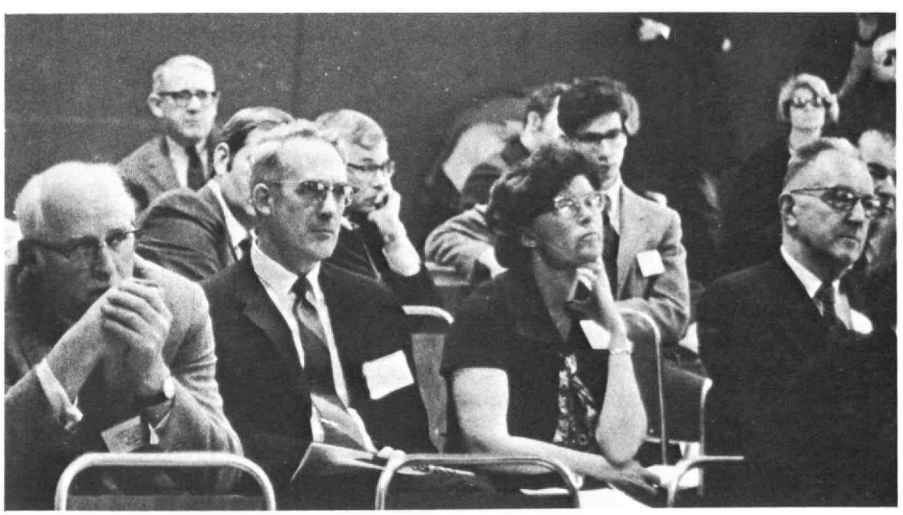
Indeed, the delegates even applauded when they were told that their efforts are or will be fruitless. Gustav Heningburg, the young black President of the Greater Newark Urban Coalition, won warm applause when he declared that organized crime has made better use of science and technology in the ghetto than many municipal governments. Applause also went to John Rees, spokesman for the activist student group, the Science Action Coordinating Committee, who criticized the idea of re-applying military and space technology on the domestic front: "The D.O.D. precedent has resulted in mismanagement, overrun, and waste. Do you really want to apply this esteemed

Pious sentiment and hard fact were curiously unconnected during the Eastern Regional Conference on Science and Technology in Public Programs sponsored at M.I.T. by the New England Economic Research Foundation early this spring. Walter Niessen of Arthur D. Little, Inc., warned that solid waste is increasing at 2 per cent a year—and its composition is predicted to change according to the chart opposite; he thus offered no comfort to public planners present. Senator Edward M. Kennedy (left) called for new resources for socially useful research and announced that he was soon to move to increase by $50 million the National Science Foundation's fiscal 1971 budget. But persistent doubt as to the efficacy of more technology in the public sector seemed reflected on delegates' faces (below) throughout the meeting. (Photo: Richard D. Koolish)

systems analysis to people? . . . Maybe these are problems which can't be solved by more technology."

The rather bleak speechscape was broken, however, by some cautious optimism. Donald A. Schon, President of the Organization for Social and Technological Innovation, Inc., pleaded for flexibility in planning and action (*see page 76*). Arthur D. Little's Peter E. Glazer suggested a marketing answer: let's specify the functions we need, rather than the product, for example, by asking for "shelters rather than low-income housing, or low-pollution transportation systems rather than improved, internal combustion engines for automobiles." Chandler H. Stevens, formerly a special staff member for Luis A. Ferre, Governor of Puerto Rico, who set up a citizen feedback system there, was also optimistic: "Science and technology can be more fruitfully applied to citizen feedback than to practically any other problem."

Yet, despite the frustrations of these specialists, the key fact remains: the drive to move our technological expertise from space and military applications into the domestic arena has gained enormous public, and political, weight. When Senator Edward M. Kennedy of Massachusetts wrapped up the conference, he declared, "For over a generation, we have oriented our scientific talent and resources toward military purposes. . . . We must now take the financial and intellectual resources which have been invested in defense and defense-related industries and convert them to the most socially useful purposes."



Might the Engineer Himself Be the Problem?

"When all the singing is over, will the malady linger on?" In officialese: the role of the engineer in using science and technology for social good, or something like that. The difference between the two aptly shows the crucial difference between the way in which engineers are presently viewed by themselves and by the public, and the way in which they must be viewed if they are to be able to help with the sort of environmental and social problems we face. One has wit and creativity; the other is dull and functional—and, as the speaker explained—tacked on so the paper would progress through channels.

Myron Tribus, an engineer who is now the Assistant Secretary for Science and Technology, Department of Commerce, described this dichotomy to the Eastern Regional Conference (*see right*) as a rarely discussed influence on the potential solutions of our environmental problems.

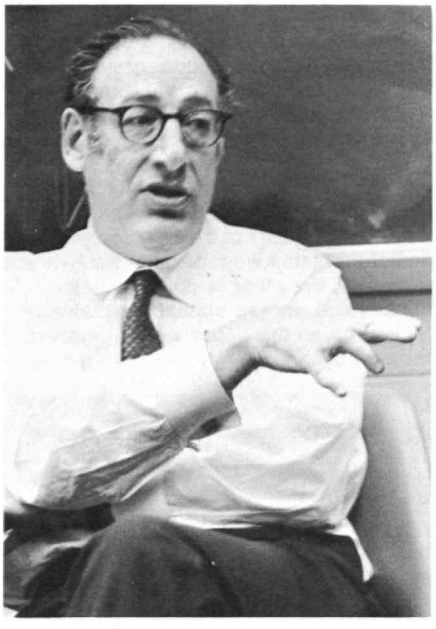
The present "crunch" comes, he said, when the hardware—the mechanical and physical implements of technology—and the software—the laws, contracts, politics, and desires of the people—collide with each other. There are all too few people who can function at this interface. Engineers might do well to do so—perhaps they must—but nobody is used to seeing them in this role, least of all themselves. (For example, a friend asks, upon accepting a public position, Do you, honestly, think I'm no longer an engineer?)

The general self-image, and public image, is that of a "technological eunuch," capable of building but not of seeing what must be built. Engineers are not thought to have the "imagination" needed, and Mr. Tribus suggests that it may well be bred or burned out of them while still in school. "Teachers of engineering are like defective DNA particles, breeding more teachers of engineering who also believe that the engineer cannot create, who teach more engineers, who in turn teach . . ."

Part of what must change is engineering education. It must contain experiences which enable a student to step outside his narrow view of himself. Another part is the engineer's reluctance to take a directorial role. Especially these social and environmental problems demand these changes, Mr. Tribus suggests, because the public does not itself know what it wants. It cannot give the direction engineers are accustomed to having. Social involvement must be seen as a step up in the profession—not a step out of it.

As soon as an engineer's attitude changes, the choices of activity are unlimited: "There is no improper way to propose to a girl, once you decide you want to do it."

How to Report Modern Complexity



Among those deliberating "The Mass Communication of Complicated Issues"—i.e. how well do the media do their job, especially after the attacks by Vice-President Spiro T. Agnew—are Fred W. Friendly, formerly Vice-President, C.B.S. News (top) and Mike Wallace, C.B.S. News Correspondent (bottom). The workshops and evening panel discussion were held at M.I.T. in early spring. (Photos: Harold Federow)

How seriously do professional newsmen take the threats to press freedom represented in Vice-President Spiro Agnew's occasional assaults and in government claims of newsmen's unpublished files?

Four of their number, speaking in a Karl Taylor Compton Seminar at M.I.T. this spring, were unanimous: very seriously. Mike Wallace, C.B.S. news correspondent, warned that "encroachments on the press will continue until the President closes open season on the media." And Fred Friendly, former President of C.B.S. News who is now consultant to the Ford Foundation, said, "If we wait too long to be shocked out of our complacency . . . we will be too weak and withered to stand up."

The announced topic was "Mass Communication of Complicated Issues," on which—in addition to Wallace and Friendly—Edwin Diamond, Senior Editor of *Newsweek,* and Thomas Winship, Editor of the *Boston Globe,* were speakers. James R. Killian, Jr., Chairman of the M.I.T. Corporation, was moderator.

The press' effectiveness on "complicated" issues was equated almost immediately with its freedom. For example, said Mr. Friendly, the press has become a handy whipping post for Washington officials who blame it for the increase in student violence. The Vice-President suggests that by reporting on the protest movement, the media have become a mouthpiece for it. But, Mr. Wallace countered, not reporting events will not stop them from happening; the far greater crime will be that no one will know about them.

On the other hand, he said, the most profound criticism of the media comes from the public, who complain that newspapers don't give enough news background—do not, indeed, deal fully enough with complex issues.

It is not that the press has interpreted the First Amendment too liberally but rather that it has failed to advocate, said both Mr. Diamond and Mr. Winship. The latter cautioned against a simplistic role of the power of the press; making reform is a "fragile business," said Mr. Winship; but the power of the editor to win changes is second only to the power of the politician.

Mr. Diamond blamed the Nixon Administration less for repression of the press than for failure to ensure freedom of the press. He suggested "no-strings" Congressional support and he urged that the public do some "boat-rocking" of its own on the question of press freedom.

N.A.S.A. Yields to D.O.T.

The Department of Transportation will succeed the National Aeronautics and Space Administration as proprietor of the research complex now nearing completion in Kendall Square, Cambridge, originally designed and built as N.A.S.A.'s Electronics Research Center.

The E.R.C. itself will go out of business on July 1 (*see* Technology Review *for March, pp. 87-88*), just when the new buildings were scheduled to be occupied. But the gloom which descended upon Cambridge when that announcement was made by President Richard M. Nixon this winter is not yet fully dispelled. James C. Elms, E.R.C. Director, has written the Center's employees that "the majority of us will be able to stay together and attack a new and exciting challenge." But, he added, "the Department of Transportation will not be able to employ the entire E.R.C. work force."

Speculating on the meaning of this, Victor K. McElheny wrote in the *Boston Globe* that "the axe is expected to fall particularly heavily on two basic research groups in E.R.C., the Electronic Materials and the Electronic Components Laboratories."

The *Harvard Crimson* quoted Howard W. Emmons, Gordon McKay Professor of Mechanical Engineering at Harvard, saying that the transfer is "an ideal arrangement. The Department of Transportation needs a real research facility," he said. But M.I.T. officials were less sanguine, pointing out that many of the problems D.O.T. listed for study in its shiny new research center were in fact the subjects of proposals which M.I.T. faculty have made for research funds from the Department.

Youth and Legislator United

Despite the numbers of words printed on pollution and related issues recently, many qualified people, young and old, are discovering that it's hard to find actual jobs—either paying or volunteer—in the field of environment.

When the nation became alerted to urban crisis and the problems of the ghettos, a host of volunteer groups found useful teaching, employment counseling, and other jobs in the inner city. And before that, after Sputnik, when the Space Age was born, jobs in aerospace mushroomed. But with Environment—which President Nixon has termed the greatest challenge before the nation—similar opportunities have failed so far to materialize.

A small example is the problems met by two staff workers at M.I.T. earlier this year who tried to match undergraduate and graduate students to research projects in pollution. Despite the encouraging 30-odd people who appeared at preliminary meetings, there were many problems in organizing, supervising, and finding uses for the research projects.

However, employment opportunities may be opening up to people trained in science and engineering in an unexpected quarter: the state legislature. All 280 legislators in the Great and General Court of the Commonwealth of Massachusetts, as it is formally titled, are up for re-election this fall: they need issues and staff to research them. In addition, Boston's mayor Kevin White, who has made curbing of polluting fuels in city plants a major issue, is challenging Francis W. Sargent, who has already gathered together a group of students interested in environment, for the governorship of the state. Finally, ordinary legislative committees need researchers—Social Welfare, Natural Resources, and Agriculture, and Urban Affairs and Transportation are the main committees which deal with the 370 bills relating to the environment submitted in a single legislative session.

These research jobs involve studying and summarizing existing legislation which relates to a proposed bill, matching this result with existing studies and available data on the subject, and, where information is scarce, requesting comprehensive research by the State House's own 13-man Legislative Research Bureau. Traditionally, this work has been done by people with legal backgrounds; but Benjamin Nason, a registered lobbyist who is Executive Director of the Massachusetts Forests and Parks Association, which represents the interests of conservation groups across the state before the legislature, feels that this work could be done as well or better by people with a technical background (*see right*).

However, a legislator typically feels some inhibitions about hiring student researchers, Mr. Nason says. A graduate student is preferable to an undergraduate, since an experienced politician is not about to risk his career by making a major policy shift on the basis of a single undergraduate paper. He is equally unwilling to fund any basic research. Finally, since voting on the floor, committee calendars, and other events operate on tight deadlines, a researcher who can appear regularly—every morning, say—is preferable to one who can appear only occasionally.

However, there are few college courses in the Boston area which teach the technically trained student how basic data interacts with government processes to become policy. Why not then, learn it at the State House?

Massachusetts: Employer for Youthful Environmentalists?

A key fact about the environment issue is that it involves masses of people. Decisions concerning the environment, therefore, must be made, not in individuals' homes or in campus or laboratory, but in the halls of state and federal governments and legislative bodies.

For this reason, local government can provide jobs—both volunteer and paying—to students and young people interested in working on environmental problems. Benjamin Nason, Executive Director of the Mass. Forest and Parks Association, listed to *Technology Review* the key environmental legislation which the State of Massachusetts will decide this term—all of which needs more research:

1. *General enabling measures.* An Environment Bill of Rights is now being considered which would entitle state residents to a better environment. In addition, a proposed "rights of action" bill would enable the citizen to take action against polluters. Also, Governor Sargent has proposed an Environmental Quality Control Council, which would have broad powers to regulate individual and community hazards.

2. *Boston Harbor.* Some 10 separate bills have been filed which would affect the ownership and uses of Boston Harbor. "Everybody has made studies—the League of Women Voters, the Sierra Club, M.I.T., the Metropolitan Area Planning Council," Mr. Nason said. "We need someone to go through the material, summarize it and come up with conclusions."

3. *Pesticides.* Another 10 bills now before the legislature deal with pesticides, and the Committee on Social Welfare is now considering measures which would extend existing controls.

4. *Solid Waste Disposal.* In the area of solid waste disposal, the basic information on problems and alternatives is known. The main question now is how individual communities can install disposal plants aided by funds authorized under a comprehensive state law passed in 1968.

5. *Noise Pollution.* Legislators from East Boston and Winthrop, the communities nearest Boston's Logan International Airport, are up for re-election this year; they are deeply concerned about possible airport expansion, and the resulting noise levels.

6. *Air Pollution.* (see Technology Review *for February, 1970, pp. 72-74).* Some 14 bills have been introduced in just one legislative session for control automotive sources of air pollution, including two which would ban totally the internal combustion engine by 1975! In addition, some 30-odd bills are on file proposing controls of other kinds of air pollution.

From Destruction to Education

On April 15, urged by Abbie Hoffman's call at a Boston Common "peace" rally to "cradle a rock" instead of "rocking the cradle," some 2,000 young militants gave Harvard Square its first experience with "trashing;" at least $100,000 of property damage and 200 injuries resulted from a four-hour riot. Just three weeks later at least as many young people armed with literature, telegraph blanks, and post cards were spreading across the Boston area to urge their fellow-citizens to express opposition to the increasing polarization of American leadership, the student deaths at Kent State University, and the growing American involvement in Cambodia which President Nixon had just announced—and to communicate their concern to their government. During the intervening three weeks, the student protest against Vietnam gained the leadership and maturity to make it at once a national power and a profound educational experience for participants.

Official M.I.T. events began at a special faculty meeting on May 5. President Howard W. Johnson, noting the anguish felt in the wake of the Cambodian escalation, asked the M.I.T. faculty's advice in recognition of "the profound interference of these events with the educational process."
He suggested—and the faculty approved by more than five to one—that formal classes by suspended for the balance of the week as a move to provide "maximum flexibility" in scheduling and fulfilling academic obligations. Instructors were encouraged "to continue to meet informally during this period with their students who desire to meet with them," and it is clear that—though procedures varied widely between departments—many teachers and students continued their academic work in both classrooms and laboratories.

By the end of the week a special faculty committee, moved by an unprecedented outpouring of constructive political activity in which great numbers of the M.I.T. community had participated following the May 5 resolution, was ready to formalize such flexible educational arrangements for the remaining two weeks of the term. The faculty voted overwhelmingly for a five-point plan:

1. Students who wish to complete their work in a normal manner may do so. They will receive standard grades.
2. Students who were doing satisfactory work before May 4 but who do not complete the term will receive academic credit for their work.
3. Students not graduating may arrange for additional work before next January 31 and receive standard grades.
4. Students who were not making satisfactory progress before May 4 may arrange with instructors to continue their work. If they do not, they will receive no credit.
5. Candidates for master's and doctor's degrees may complete their theses either by the usual date of June 4 or during the summer session.

Reporting to alumni officers on May 14, President Johnson said that M.I.T. "remains in session." Commencement exercises are scheduled for June 12.

The special committee, in recommending its plan, had told the faculty that, in its opinion, "academic activities cannot proceed in normal fashion in the present situation. In our considerations we have therefore attempted to formulate procedures for the remainder of the academic term that are responsible and flexible and that respect the range of commitments of all concerned." After the faculty meeting, President Johnson said that the plan "acknowledges the educational obligation of the faculty and of the Institute."

Even before the faculty had acted on May 5, a student Moratorium Committee had set up headquarters in the Bush Room at M.I.T. which quickly became the unofficial "command center." From here were coordinated growing activities *(see adjacent columns)* which spread into the Boston area. The students began by calling their effort a "strike"—not against M.I.T. but against the government. But most quickly realized that "strike" was the wrong word.

"To Be Understood . . ."

Howard W. Johnson and Jerome B. Wiesner, President and Provost, respectively, of M.I.T., called on May 4 for "a constructive and creative response" from academic communities throughout the country to what they described as "a tearing time for the nation."

"The problem of institutions like ours," they said in a joint personal statement, "is to keep our reactions from being self-destructive at a time when the country needs (its universities) to be stronger than ever.

"The process of communicating with our representatives and our fellow citizens . . . can be used much more effectively than it has been used. Let us in these next days," they said, "develop modes of expression and action that can be understood by our fellow citizens. Let us use the resources and talents we have to educate ourselves and our fellow citizens."

Telegrams vs. Rocks

Canvassing conducted by M.I.T. students through the Moratorium Committee headquarters—as many as 300 students were involved every day during the week of May 4—had a double purpose: to discuss the Cambodia move with citizens and to forward messages (telegrams or postcards) and petitions to Congress.

Throughout the week more than 70 booths were operated in the Greater Boston area—at key intersections, in subway stations, on park benches. Canvassers also went to some 35 shopping centers in suburban towns. A business canvass urged "clean-cut" students to knock on doors of business establishments (some were admitted, some not).

In one week 10,200 telegrams had been sent to Washington. Though three-hour shifts were arranged, many students chose to stay on the job all day. "It's better than throwing rocks," said a Sigma Chi fraternity man on duty at Boston's Government Center.

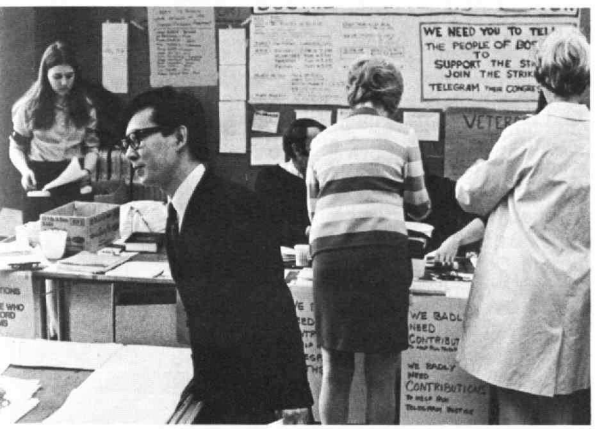
Cambodia Teach-Out

The teach-in with a new twist began during the week of May 4 in a unique, multi-university effort to canvass homes of the so-called "silent majority." Originated by a former candidate for Congress, Chandler H. Stevens, Senior Lecturer in the Sloan School, the canvas sent at its height 300 students into Boston and Cambridge ringing doorbells to gather sentiment on the Cambodian situation as well as signatures for Vietnam and legislative referendum petitions.

Out of Town: Boston, New York

Many efforts involved direct communication with those who might be able to exert pressure for change. The first excursion came when Nobel Laureate Salvador E. Luria, Sedgwick Professor of Biology, suggested to a noontime dis-

Events in the U.S. and in Southeast Asia combined this month to bring a totally new spirit of political commitment to the M.I.T. campus. With increased academic flexibility, many students turned to political action, donning black armbands in mourning for the Kent State students or red ones to show concern for peace. In the M.I.T. Moratorium Committee's headquarters you could pick up fact sheets, learn the names of your Congressmen, send postcards and telegrams, sign up for neighborhood canvasses, get a daily list of Greater Boston peace activities, give money, sign up for trips to Washington and New York, and learn about peace groups with which to work during the summer. Booths were established throughout Boston; on Boston Common the students accepted as many as 50 telegrams an hour on May 5, 6, and 7. (Photos: Donald L. Estes, Jr., and Stephanie Davis)



cussion meeting on the sunny Student Center steps that the group take a walk and make its concerns known to Governor Francis W. Sargent. Thus 200 of the M.I.T. community found themselves on April 30 before the State House in Boston, where the Governor met with them.

The following Tuesday, a peaceful crowd of 15,000 students from the Boston area gathered before the State House to protest not only Cambodia but the shooting of four students at Kent State University. The Governor agreed to lower the State House flag to half-mast in mourning, and state legislators spoke to the group.

Another week later, 50 students and faculty from the Sloan School of Management joined colleagues from other business schools to visit Wall Street. Their purpose was "to demonstrate that dissent need not be radical," to distribute their economic study of the cost of the Vietnam war, and to enlist support for Business Interface, a new M.I.T.-based effort "to improve the flow of information between the business world, the academic community, and the national government.'

M.I.T. Goes to Washington

The first—and most official—of several groups travelling to Washington to discuss campus concerns made the trip on Monday, May 11, to visit with the entire Massachusetts Congressional delegation. It was a special subcommittee of the M.I.T. Corporation Joint Advisory Committee on Institute-Wide Affairs, whose trip had been suggested—and was led—by President Johnson and James R. Killian, Jr., Chairman of the Corporation.

Though Washington was full of college delegations, the M.I.T. group found a ready audience for their concerns and questions on Capitol Hill—and later at the State Department (Under Secretary Elliot L. Richardson and—briefly—the Secretary, William P. Rogers) and the White House (Daniel P. Moynihan, former Director of the Joint Center for Urban Studies of Harvard and M.I.T.).

"I don't see how anyone could go through that day without feeling that Congress is responsive and serious," President Johnson said upon returning.

As this report goes to press, some 150 members of the M.I.T. community were departing for Washington conferences with Congressmen in a program called the "Washington Lobby," organized through the Moratorium Committee by Charles Mann, an M.I.T. undergraduate.

"... Perish by the Sword"

When President Howard W. Johnson told the faculty on May 5 that a second Kresge Auditorium meeting would be necessary on Sunday evening, May 10, to consider how M.I.T. should finish the term after the three-day suspension of classes just voted, Klaus Liepmann, Director of Music, raised his hand.

The trouble, he said, is that the Choral Society is singing the St. Matthew Passion here then. And then, confessing that it was his first "speech" to the faculty in 23 years at M.I.T. ("I prefer to speak with music"), he said, "I do not think that this great work is irrelevant. You have only to remember that it contains the sentence 'Whosoever lives by the sword shall perish by the sword' in order to see how much it deals with the problems of our days.

"All this reminds me sadly of the Hitler years in Germany, when it became customary to invade peaceful countries in order to 'liberate them from communists;' when citizens were turned against each other, one side calling the other 'communists, traitors, bums;' when atrocities were committed in the name of law and order. I sense, however, and I see a decisive difference between Germany then and the United States today.

"In Germany great masses of people, notably the intellectuals, remained passive—they called it non-political. Nobody rose and fought Hitler except the Socialists and Communists who were beaten, shot and tortured by the forces of so-called Law and Order. The cowardice of the German people delayed action until it was too late.

"I feel it our duty as intellectuals and artists to speak up now and to act now. We must now make it clear to the government that its policies are leading inevitably to revolution as well as continually expanding war."

When the standing ovation subsided, the M.I.T. faculty quickly adopted by large majorities resolutions opposing the invasion of Cambodia, the continuing war in Vietnam, and "the growing suppression of political dissent;" and asking that "the Congress assume its responsibility over the ultimate questions of war and peace."

The Radicals: Empty Sails

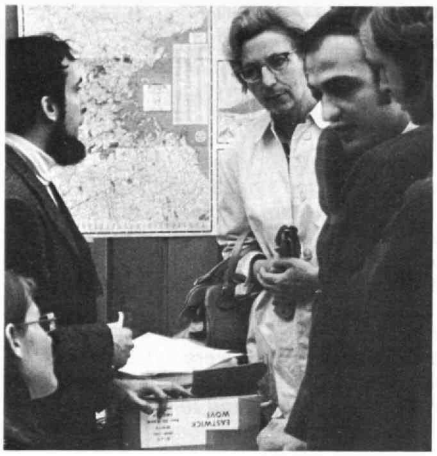
As campus events progressed during the days after May 5, majority support was firmly for constructive canvassing and/or getting back to studies; interest in M.I.T.'s small band of radicals dwindled.

The radicals issued their own "strike" call around three demands: take the U.S. out of Southeast Asia, free all political prisoners, and end war research and R.O.T.C. on campus. They formed a loose coalition (of previously warring groups) which held daily "mass meetings." The first such meeting was the most important; it drew the largest non-radical representation, and it was this meeting that voted to "strike."

Other radical activities included limited canvassing in local high schools and factories, speeches, and an effort to cut off deliveries to the Institute by picketing truck entrances. There were minor incidents—and always the possibility of more serious ones.

Were those M.I.T. students on "strike" in May really out of school—or just practicing those virtues they had learned in the classroom?

Project Engineers for Spaceship Earth



To many, the word *strike* conjures up scenes of turn-of-the-century labor wars, to others, the grim headlines of the 1930's. Many students identify *strike* with Harvard in April, 1969, when students wore red armbands in the wake of the occupation of University Hall. But no one—not until it happened—could have known that none of these meanings fitted what in the beginning was called a "strike" at M.I.T. *(see previous pages).*

It was not really a traditional "strike" at all; it was simply a broad-based community judgment of priorities. The students who conceived the round-the-clock information center in a central location, the Bush Room, and others who gravitated there happened also to be fairly experienced organizers. Some had run the October 15 Moratorium march to the Boston Common. Many had been members of the student press. Most had sat on an impressive list of faculty committees.

Forty-eight hours and 180,000 sheets of mimeographed paper later, the group—now titled the M.I.T. Moratorium Committee—had 600 students at 17 booths in Cambridge and Boston, in businesses and suburban shopping centers. The goal was to provide voters with telegram blanks on which they could air their views to their representatives; the students collected the price and had the telegrams dispatched. After one week, they had so thoroughly swamped Western Union that packs of messages had to be bussed to obscure Western Union offices for transmission.

What made the M.I.T. faculty modify a perfectly healthy academic term to accommodate "strikers?" Myopia? Flabbiness? The disease of "conciliation to an unbending Left?" Was it the fault of a few individuals—either high and mighty or lower and bushier?

What Engineering Education Is all About

There was doubtless a complex of reasons for the overwhelming vote for "maximum flexibility." Perhaps one reason was that the faculty saw in this activity, labeled "strike," something parallel to what they had taught for years.

The Bush Room, as an example of the many student activities of the "strike," was not too different from the project lab of any complex engineering program. It's just that the content was different: the system was larger, the components human instead of mechanical. And making a system do what you want it to do is what engineering education is all about.

The test of any project, of course, is the transfer function. A placard outside of the Bush Room read: "*In Response to 1600 Telegrams Sen. Brooke Has Introduced A Motion For Withdrawal From Cambodia In The Senate.*"

One thing students learn at M.I.T. is efficiency. During the strike I interviewed one student organizer in his H.Q. behind the Bush Room, who bustled around apologizing for his "inefficiency." He just couldn't get "efficient" enough, he complained, even though he was simultaneously counting money, making business arrangements, urging his student secretary to work faster, and finding me a list of the Congressmen with whom people from M.I.T. would confer in 48 hours. He apologized for the "embarrassingly small figure of 120"—the number of faculty and students then signed to go to Washington; and he simply refused to believe me when I told him it was a pretty good figure, after all.

Later, when I inquired about another student project, one moustached young man told me with the gravity of a seasoned bureaucrat: "Oh, you're from the press. I can't talk to you. You'll have to talk to our Press Officer." One of the keys to maintaining a system is entering every input at the proper terminal.

When I found the Press Officer, a ponytailed veteran of numerous faculty committees, she explained: "We are making copies of all student telegrams to Congress and mailing them, with a covering letter, to their home-town newspapers. That way, we will reach out to cities and towns across the country. It's called Bringing It All Back Home."

Another key to success in engineering is knowing which features are essential to the overall function of a given design. In some cases, salesmanship was the key feature. Instructions to business canvassers read: "*No armbands. No strike fists. Explain you are against violence. Don't blame Nixon.*" One fresh-faced young man presented himself to a business canvass organizer. "I heard you needed someone clean," he said. "Here I am."

In "School" or on "Strike"?

Members of the elder generation, with a pocketful of technological achievements behind them, should see that they and these students have much in common. On the other hand, there are differences they should consider. What kind of job can one offer a college graduate in engineering with this kind of experience? Would he answer a job ad now posted at M.I.T.: "Job Openings in Passive Networks. Attractive Salary. Good Fringe Benefits."

And a further challenge. What kind of corporation will such a student form, when he "comes of age?" To put it facetiously—with apologies to both sides—what would Dow Chemical be doing today were it run by the M.I.T. Moratorium Committee? More seriously, what *will* it be doing 20 years hence?

A word about the shooting of four students at Kent State University. Contrary to all prediction, this violence did not radicalize the vast majority of students. Instead, it brought home to them that demonstrating is no game, that the choices appear to be to either lose your life—physically or otherwise—by militancy, or live it by the Avis ("we try harder") method. The Kent State incident brought a resurgence of the standard football cheer "Give It One More Try!" The System, that is.

And so their professors voted that students could stay out on what, in their innocence, they called a "strike." Or what others called being in school. It didn't matter which, really. One afternoon during that first week I passed a department computer facility where a student was poised over a console, grimacing with concentration and punching furiously. On his left arm he was wearing the bright red "strike" armband. Far from abandoning his lessons, he—and many others—were learning them as never before.—D.S.

In Celebration of Spring

The most exciting event of the month in which this is written has been the arrival of spring. A local radio station, WBZ, threatened to cancel spring, and for a month it looked as though they weren't kidding.

I must issue another plea for speed problems. The supply is critically low.

Problems

31 The first problem is from Samuel S. Wagstaff, Jr., who recalls Leslie R. Axelrod's comment in the July/August, 1969, issue that 1,729 is an "interesting" number because "it is the first number which is the sum of two cubes." (But he notes parenthetically that Mr. Axelrod "should have taken greater care in stating that property of 1,729; he wants the number to be the sum of two *positive* cubes.") Mr. Wagstaff's problem: solve the corresponding problem for squares, fourth powers, and fifth powers.

The next offering is by Douglas J. Hoylman:

32 In a league of 2n teams, each team plays every other team exactly once during a season. What is the greatest possible number of teams that can have a winning season? (Assume no ties.)

The following is by Frank Rubin:

33 Given any triangle ABC and a point D on segment BC, find (without using calculus) points E on AC and F on AB such that triangle DEF has maximum area.

Russell A. Nahigian offers the following:

34 A census taker stops at a house, notes down the number on the door, and knocks. When a woman answers, he asks her age and notes the answer. Then he asks if anyone else lives at the house; she replies that three other people live there. Upon asking their ages he is given the reply that the sum of their ages equals the number on the door and their product equals 1,296. He does some quick computation and then asks if the oldest of the three is older than the woman he is talking to. She replies that the oldest of the three is younger than she. What were the ages of the three? What is the house number?

Warren Himmelberger submits the following bridge problem—supposedly, he says, a hand played in a public match half-a-dozen years ago.

35 Given the following hand, with the bidding as indicated, show how the declarer can take 11 tricks, assuming the diamond finesse must be successful.

	♠ 8 4 2 ♥ A 6 5 ♦ Q J 9 8 ♣ K 8 7	
♠ A Q 9 6 3 ♥ K Q J 10 8 7 ♦ — ♣ 10 3		♠ J 10 ♥ 9 3 2 ♦ K 7 6 5 4 3 2 ♣ 9
	♠ K 7 5 ♥ 4 ♦ A 10 ♣ A Q J 6 5 4 2	

The bidding started with South one club, West doubled, North redoubled, and East bid one diamond. South responded with three clubs, West four hearts, North five clubs, and East pass. West opens with ♠K.

Speed Department

The only contributor is John E. Prussing:

SD12 Show that the product of all primes less than 1,000 is an even number.

SD13 Here is a proof that all integers are odd:
Let P(n) denote the proposition that 1,2,3,...,n are all odd integers. The proof follows by induction:
1. P(1) obviously.
2. Assume P(k). If 1,2,...,k are all odd, then k − 1 is odd. By adding 2 to k − 1, one shows that k + 1 is also odd.
3. Thus P(k) implies P(k + 1) and the proof is complete.
What is the fallacy?

Solutions

14 Find a function f defined on the entire real line such that

1. f is bounded and strictly increasing;
2. f is continuous at each point x; and
3. $\lim_{x \to -\infty} f'(x) \neq 0 \neq \lim_{x \to \infty} f'(x)$.

Here is John E. Prussing's solution:
An example of such a function is the bounded, continuous, monotonic function defined by
$f(x) = 1 - e^{-x}$ for $x \geq 0$.
For $x < 0$, $f(x) = -f(-x)$.
Since for this function
$\lim_{x \to -\infty} f'(x) = 0 = \lim_{x \to \infty} f'(x)$,
we must also include a discontinuity in f' at $\pm \infty$. This discontinuity in f' will not affect the above-named properties. If having the discontinuity at infinity is unesthetic, one could map the interval $(0, \infty)$ into the interval (0, 1) by the transformation $y = x/(1 + x)$ and place the discontinuity at $y = 1$.

Also solved by John Pierce, Peter Ross, Mark Yu, Frank Rubin, R. Robinson Rowe, and Homer D. Schaaf.

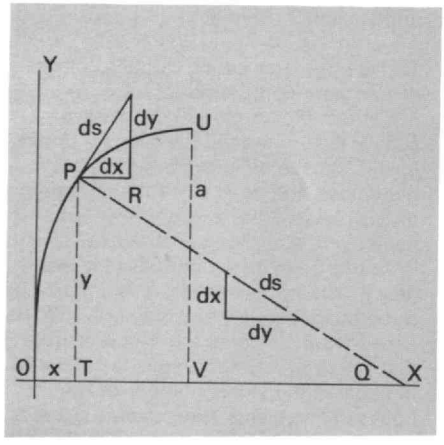
15 This problem was a variation of one of last year's problems:
A mathematician moonlighting as a census-taker stops at his friend's house. In this census he is required to obtain the names and ages of all the occupants of the house. After writing down several names and ages the census-taker asks, "Are there any more people who live here?" His friend replies, "Yes, there are three more people that live here." When asked for their ages, the friend reports that the product of the ages is 1296 and the sum is the street number of his house. The census taker makes a few calculations and then says, "Just tell me one more thing: How many of the three are older than you are?" As soon as his friend replies, the census taker smiles, writes down the ages and leaves. What is the house number?
The variation proposes that two veterans (i.e., older than 18) discuss a similar situation where the house number is not known. One veteran asks how many of them are older. Which reply allows him to determine the house number?

Frank Rubin responds as follows:
This problem is undoubtedly the most unclearly stated problem you have ever

published. But to make a stab at it, I make the following assumptions:
1. The veterans are the census taker and his informant, not the three remaining occupants of the house.
2. The age of the informant is known to the census taken but not to us. We simply know that he is older than 18.
To solve this problem, we first write down the 40 or so factorizations of 1296, and then consider the information that each of the four answers gives us:
1. If he says none is older than I am, there are several possible factorizations if the informant is 19: $9 \times 9 \times 16$, $8 \times 9 \times 18$, and $6 \times 12 \times 18$. The older the informant, the more factorizations.
2. If he says one is older than I am, and if the informant is 432 to 647 years, then there is just one factorization: $1 \times 2 \times 648$. Otherwise there are multiple factorizations (down to age 2).
3. If he says two are older than I am, and he is 27 to 35, then the only factorization is $1 \times 36 \times 36$. Older than 35 is impossible, and every age 19 to 26 admits multiple factorizations (e.g., $1 \times 27 \times 48$).
Since we assume the informant is under 432 years, condition 3 is the only one admitting a unique factorization. The house number is then $1 + 36 + 36 = 73$. But neither this problem nor the original explains how the census taker matched the correct age with each of the three names.

Also solved by R. Robinson Rowe, Smith D. Turner, and Patrick J. Sullivan.

16 Find a curve having nonconstant radius of curvature such that all the centers of curvature lie on the x axis.



The only solution is from R. Robinson Rowe, who rephrases the problem to find a curve with its evolute on the x axis:

Let $y = F(x)$, $y' = dy/dx$, $y'' = d^2y/dx^2$, $ds^2 = dx^2 + dy^2$, $s' = ds/dx = \sqrt{1 + y'^2}$. In the figure, at P on the curve the radius of curvature $R = PQ$ is normal to the curve, and the center of curvature Q is required to be on the x axis. From similarity of triangle PQT to the differential triangle,

$$R = y\,ds/dx = ys' = y\sqrt{1 + y'^2}. \quad (1)$$

From calculus, the general equation for curvature is

$$R = (1 + y'^2)^{3/2}/y''. \quad (2)$$

Equating (1) and (2),

$$y\sqrt{1 + y'^2} = (1 + y'^2)^{3/2}/y''$$

$$yy'' = 1 + y'^2 \quad (3)$$

With boundary conditions $x = y = 0$, $y' = \infty$, and the first integration yields

$$y' = \sqrt{a^4 - y^4}/y^2 \quad (4)$$

defining an upper boundary at $y = a$ where $y' = 0$. It will be expedient to deal with a unit curve from which all others may be derived by a scale factor. Making $a = 1$ and separating the variables,

$$dx = y^2dy/\sqrt{1 - y^4}. \quad (5)$$

This elliptic integral of the second kind may be solved by series or by elliptic functions. For the series solution,

$$dx = y^2(1 - y^4)^{-1/2}dy = (y^2 + \tfrac{1}{2}y^6 + 3y^{10}/8 + \ldots)dy \quad (6)$$

$$x = y^3\,(1/3 + y^4/14 + 3y^8/88 + y^{12}/48 + 35y^{16}/2{,}432 + \ldots). \quad (7)$$

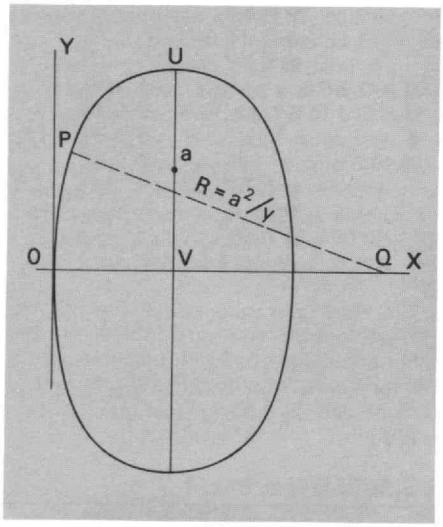
And for the so-called exact solution, the transformation

$$y = (\sin\phi)/\sqrt{1 + \cos^2\phi},\ dy/d\phi = (2\cos\phi)/(1 + \cos^2\phi)^{3/2},\ 1 + \cos^2\phi = 2(1 - k^2\sin^2\phi),\ k^2 = \tfrac{1}{2} \quad (8)$$

converts (5) to a tabular form and direct solution:

$$x = k^3 \int (\sin^2\phi\ d\phi)/(1 - k^2\sin^2\phi)^{3/2} \quad (9)$$

$$= \sqrt{2}\,[E(\phi,k) - \tfrac{1}{2}F(\phi,k)] - y\cos\phi. \quad (10)$$



Equation (10) defines the curve from O to U, the latter point being located by $y = 1$ and the complete elliptic integrals,

$$x_u = \sqrt{2}\,(E - \tfrac{1}{2}K) = 0.599\,070\,1202. \quad (11)$$

Obviously, by reflections, the arc OU is only one quadrant of the entire curve (drawn below), a flat-sided oval centered at V, with a major diameter of 2 and a minor diameter near 1.2.
After all this, Mr. Robinson is kind enough to say, "I enjoyed this incentive to review elliptic integrals, after 50 years of neglect."

17 I placed 15 dimes and 15 nickels in six cups such that each cup contained the same number of coins but a different amount of money. I made six labels showing correctly how much money each cup contained, but attached to each cup an incorrect label. I explained the situation to six logicians and gave a cup to each. I asked each man in turn to feel the size of as many coins as he wanted in his own cup and announce something interesting. The only evidence each man had was the size of the coins he felt, the incorrect label on his own cup, and the statements made by those who preceded him. The first man said, "I feel four coins which are not all the same size; I know that my fifth coin must be a dime." The second man said, "I feel four coins which are all the same size; I know that my fifth coin must be a nickel." The third man said, "I feel two coins, but I shall tell you nothing about their size; I know what my other three coins must be." The fourth man said, "I feel one coin; I know what my other four must be." The problem is to determine how the remaining two cups were labeled and what the total value of the money in those two cups was.

The following is from Captain John Woolston:
The first man knew what coins he had. The other men knew that he had: (a) three nickels, two dimes, and a 30¢ label; (b) two nickels, three dimes, and a 35¢ label (which he knows himself); or (c) one nickel, four dimes, and a 40¢ label. The second man also knew what he had, and everyone else knew that he had either (a) four dimes, a nickel, and a 50¢ label (as he knows himself) or (b) five nickels and a 30¢ label. Incidentally, his answer is independent of the first man's answer.
The third man had to think and trust the first two men. What he felt was a nickel and a dime, and his label said 30¢. Consequently, he knew that the second man had 45¢ and a 50¢ label (since he held the 30¢ label himself), so that the first man had 40¢ and a 35¢ label (since the second man held 45¢ and he held the 30¢ label). Knowing that he had a nickel and a dime (which he needed to know to eliminate 25¢ and 50¢), his possibilities were (a) 30¢, which is impossible since he had a 30¢ label; (b) 35¢, which he actually had; (c) 40¢, which he couldn't have since the first man had it; or (d) 45¢, which he couldn't have because the second man had it. The other men know that this combination is the only one the third man can have which would allow him to know his holdings after feeling only two coins. This is because two coins can only eliminate 25¢ and 30¢ or 25¢ and 50¢ or 45¢ and 50¢, and the 30¢ label is the only one which brings the possibilities within the range.
So now everyone knows what the first three men have—both coins and labels. The fourth man felt a nickel and saw a 25¢ label. He knows he cannot have 50¢ because of his nickel and he cannot have 25¢ because of his label, so he must have 30¢. Everyone else knows that he has 30¢ and a 25¢ label, since one coin can only eliminate 25¢ or 50¢, and neither of the other two labels brings a solution within range. At this point, the last two men have 50¢ and 25¢ and the 40¢ and 45¢ labels for a total of 75¢. They also know this without feeling and without looking at their labels; hence, one feel

and they know which coins they have.

Also solved by James W. Dotson, Stanley Horowitz, R. Robinson Rowe, Kenneth L. Zwick, and the proposer, David P. Dewan.

18 Fill in the digits in this multiplication problem, using each of the 10 digits (0, 1, 2, . . . 9) exactly twice:

```
    x x x
    x x x
  -------
    x x x
  x x x
x x x
-------
x x x x x
```

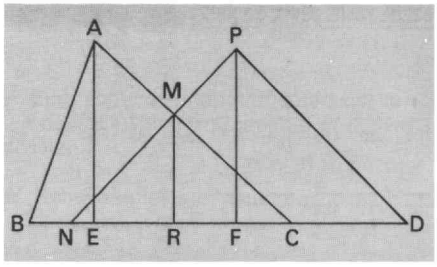
The following is from Hubert du B. ("Lucky") Lewis:

```
    1 7 9
    2 2 4
  -------
    7 1 6
  3 5 8
3 5 8
-------
4 0 0 9 6
```

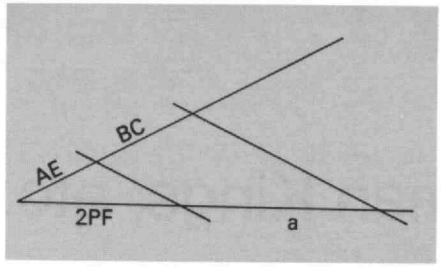
By inspection, the multiplicand must be less than 400. By quick elimination, the multiplicand must be one-hundred-something, and the multiplier must then be 223 or higher. It was not 223, and 224 came next.

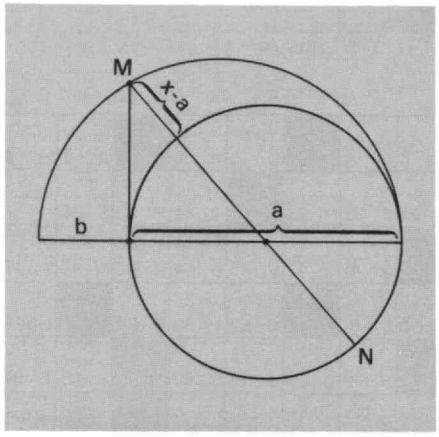
Also solved by Richard A. Bator, Richard P. Bishop, Robert J. Swaney, R. Robinson Rowe, John P. Rudy, and the proposer, Thomas B. Jabine.

19 Given a triangle ABC and a point P, find a method for constructing a line through P bisecting the area of the triangle.



The following from Smith D. Turner:
The given triangle in the drawing is ABC, the given point is P. PN is therefore the required line. PD is parallel to AC. AE, MR, and PF are perpendiculars. On the basis of areas,
2 x MR x NC = AE x BC.
But since triangles MNC and PND are similar,
MR/NC = PF/(NC + CD).
Eliminate MR from this pair of equations and the result may be arranged
NC [NC − (AE x BC)/2PF] =
(AE x BC)/2PF x CD,
or, say,
X(X − a) = ab
Now a is merely the fourth proportional to three known lines—AE, 2PF, and BC—and so may be constructed. Therefore ab is a known area, and X may be found—a side of a rectangle where the area and the difference of sides is known. With NC = X known, PN is drawn.





Also solved by R. Robinson Rowe and Captain John Woolston.

20 A said to the farmer, "I know you own a rectangular plot in that 20-by-20 section, and I know the area of your plot. Is the length greater than twice the width?" B said to the farmer, "Before you answer let me state that I knew the width, and I now know the length." C said, "I did not know the length, width, or area; but now I know the dimensions." What are they?

The following is from Christopher Brooks:
The trick to solving this problem is to read between the lines. A asks, ". . . Is the length greater than twice the width?" which must be taken to indicate that the length of the plot *could* be greater than twice the width (and fit into a 20 x 20 section). Since $L_{max} = 20$, W must be ≤ 10. Therefore $A \leq 200$. B knew the width, and since $L \geq W$, B knew that $A \geq W^2$. Thus, for B to infer the length of the plot from A's question, we must have $A = W^2 = 200$, and $L = W = 10\sqrt{2}$.

Also solved by James W. Dotson, Stanley Horowitz, Benjamin Fulbright, Captain John Woolston, Richard P. Bishop, and Frank Rubin.

Better Late Than Never

Additional answers have been received on this year's problems, as follow.

1 Frank Rubin

3 Dudley F. Churd has found four other ways to make the hand. Also solved by Winslow H. Hartford, Patrick J. Sullivan and Captain John Woolson

4 John G. Maier, Frank Rubin and Captain John Woolson

5 Frank Rubin

6 James L. Larsen

7 Anonymous and James L. Larsen

9 Frank Rubin and James L. Larsen

10 The proposer, Henry S. Lieberman, notes that Thomas Sadler's proof was incomplete. He writes, "While everything that Mr. Sadler has done is correct, he has not completed the solution. Indeed, Mr. Sadler asserts correctly that the two conjugacy classes of G are {e} and G − {e}. Let's take the first question: If G is assumed to be finite . . . Let $n = \#G$. Then $\#(G - \{e\}) = n - 1$. But the order of a conjugacy class must divide the order of the group. Thus, $n - 1 | n$. Now the only instance in which this can happen is if $n - 1 = 1$, i.e., $n = 2$. Thus $\#G = 2$, i.e., G is the (cyclic) group of order 2. As for the second question, let us make use of Mr. Sadler's correct assertion that $\#G = p^r$, where p is prime. Now it is well known that G has a nontrivial center. But the center is a normal subgroup and therefore the union of conjugacy classes. Therefore, in our case G equals its center and is thus abelian. But the number of conjugacy classes of an abelian group is the same as the order of the group! Whence, again we must have $\#G = 2$. Hence in either case G is the (cyclic) group of order 2."

In later correspondence Mr. Lieberman notes that the above is also not complete and repairs it as follows:
"What I failed to notice is that Mr. Sadler's conclusion that $G = p^r$, p prime, is based on the assumption that G is finite. But to handle the case for which G is assumed to have a nontrivial element of finite order, we cannot also assume that G is finite. For this case let me provide my oft-promised combinatorial proof. I claim that in this case also G is the group of order 2. The proof is as follows: Mr. Sadler has already correctly shown that every nontrivial element of G has the same order m and m must be prime. Assume m is an odd prime. Let $x \neq e$. Then $\exists\, g \neq e \in G$ such that $x^{m-1} = g \times g^{-1}$. Hence $(x^{-1})^{-1} = (g \times g^{-1})^{-1} = (g^{-1})^{-1} x^{-1} g^{-1}$, i.e., $x = gx^{-1}g^{-1} = [g(g \times g^{-1})g^{-1}] = g^2 \times g^{-2}$. Indeed, it follows that $x = g^k \times g^{-k}$ for all even k. In particular, $x = g^{m-1} \times g^{-(m-1)}$, i.e., $x = g^{-1} \times g$ or $x = g \times g^{-1}$. We thus have $x = x^{-1}$, or $x^2 = e$. But this contradicts that m is odd. Hence, m is an even prime, i.e., $m = 2$. But this x requires that G is abelian, whence we must have $\#G = 2$. This settles the matter."

Allan J. Gottlieb studied mathematics at M.I.T. with the Class of 1967 and is now a Teaching Assistant at Brandeis University. Send answers, problems, and comments to him at the Department of Mathematics, Brandeis University, Waltham, Mass. 02154.

Tech-Crostic
David L. Holt

Eight Post-Norman Kings, etc.

								I 1	N 2	K 3	C 4		L 5	U 6		J 7	Z_1 8	M 9		S 10	B 11	Q 12	K 13		V 14
	X 15	I 16	R 17		F 18	M 19	L 20	H 21	C 22	P 23		O 24	H 25	E 26	—	C 27	S 28	M 29	A 30	K 31	F 32	W 33		
G 34	Q 35	J 36	T 37		U 38	F 39	N 40		G 41	A 42	V 43	O 44	H 45	M 46	T 47	J 48	C 49		Q 50	J 51	F 52	K 53		
Z_1 54	Y 55		U 56	T 57	P 58	M 59		E 60	S 61		Q 62	U 63	T 64		L 65	Z 66	H 67	E 68	R 69		M 70	J 71	R 72	
B 73		L 74	S 75		G 76	P 77	W 78		H 79	Q 80	J 81	C 82		R 83	T 84	V 85		K 86	D 87	F 88	J 89	M 90	E 91	
V 92	A 93		R 94	Y 95	C 96		J 97	F 98	I 99	S 100	M 101	E 102		Z_1 103	X 104	D 105		M 106	Z 107	A 108	F 109	J 110	G 111	
Y 112	Z_1 113	Q 114	X 115		L 116	S 117	Y 118		H 119	R 120	C 121	L 122	W 123	A 124	J 125	I 126		C 127	T 128	G 129	Q 130	K 131	D 132	
	X 133	O 134		V 135	F 136		O 137	G 138		M 139	L 140	J 141	D 142	Q 143	W 144		U 145	A 146	E 147	Q 148	—	Y 149	G 150	
D 151	P 152		X 153	M 154	J 155		G 156		K 157	U 158	T 159	N 160	B 161	F 162		Q 163	V 164	Z 165	G 166		B 167	S 168	U 169	
K 170	M 171	C 172	O 173	X 174		V 175	E 176	Z_1 177	K 178		S 179		D 180	Q 181	Z_1 182		I 183	M 184	P 185	X 186	G 187	N 188	B 189	
	H 190	F 191	O 192		Q 193	J 194	A 195	M 196	C 197	Z_1 198	T 199	V 200		P 201	I 202	Y 203	C 204	R 205		Z_1 206	H 207		Z 208	
E 209	S 210		Z 211	I 112		H 213	M 214	A 215	P 216	S 217	T 218	C 219	K 220		Z 221	U 222	F 223	L 224	I 225	E 226				

Use the definitions at the right to help define the words to which they refer; then enter the appropriate letters in the diagram to complete a quotation from a scientific work. The first letters of the defined words give the author and title from which the quotation is taken. Black squares in the diagram indicate the ends of words; when there is no black square at the right end of the diagram, the word continues on the next line.

The correct solution to this Tech-Crostic will appear in the June issue of *Technology Review*.

David L. Holt is Assistant Professor of Metallurgy at M.I.T. He will welcome readers' comments; address him in care of *Technology Review*, Room E19-430, M.I.T., Cambridge, Mass. 02139.

A. A wasting or consumption of the tissue. — 108 30 195 124 42 93 146 215

B. So close in structure as not to admit liquid. — 167 11 189 161 73

C. Melts or dissolves by attracting and absorbing moisture from the air. — 96 204 121 172 197 27 49 127 219
82 22 4

D. Name of eight post-Norman English (British) kings. — 151 105 180 87 142 132

E. Punished, disciplined. — 68 176 26 102 226 60 91 209 147

F. Insect order which includes bees, ants, and wasps. — 39 162 88 136 32 191 18 52 109
223 98

G. Quality of being easy to speak to, courteous, amiable, sociable. — 129 138 34 156 166 187 41 111 76
150

H. A colorless, crystalline, slightly sweet sugar. — 213 67 190 119 21 79 207 45 25

I. Any theory which views the universe as essentially constituted by forces. — 183 212 126 16 1 225 202 99

J. An apparatus for transforming a direct current into an alternating current of high potential (2 words). — 71 194 155 141 110 7 51 89 48 — 97 36 125 81

K. Levels never before reached (2 words). — 170 131 157 220 13 31 86 53 178 — 3

L. Type of brain surgery. — 122 140 65 5 116 74 224 20

M. Branch of science which treats of the laws of distribution of electric current. — 9 101 214 139 46 19 90 171 184 — 154 106 59 196 29 70

N. Sound quality; inflection; healthy elasticity: general trend; mood. — 160 2 188 40

O. A generalized concept of a vector, requiring for its description more than three components. — 134 44 173 24 137 192

P. Intellectual; highbrow. — 58 185 23 77 216 201 152

Q. That which is suitable for development, manufacture, training, etc. (2 words). — 35 193 50 12 163 62 148 130 80 — 181 114 143

R. Stemmed; approached by stealth. — 17 83 94 72 69 120 205

S. German physicist, 1686-1736. — 75 217 168 28 100 61 117 210 179 — 10

T. Instrument for measuring or regulating currents. — 159 84 57 47 37 64 128 199 218

U. Color of a clam shell (comp.). — 158 6 56 145 63 169 38 222

V. Embryonic or undifferentiated tissue, the cells of which are capable of active division. — 43 85 164 14 200 175 92 135

W. Relieve; alleviate; facilitate. — 144 123 33 78

X. Passage; aisle. — 186 133 104 174 15 153 115

Y. Native of New England. — 55 112 95 203 149 118

Z. Sacred songs or poems. — 221 107 165 66 211 208

Z_1. Largest subdivision of the diencephalon. — 206 8 177 113 103 54 198 182

Corrections of Fact and Usage

Warding Off Misunderstanding

To the Editor:
After reading the article "Warding Off Future Mid-Air Collisions" in the January, 1970, issue of *Technology Review* (page 57), I was compelled to comment on some misleading statements that I recognized in this brief article.

1. In the fifth paragraph, it is implied that "a traffic controller on the ground can estimate the position of an identifiable aircraft" through the use of V.O.R. and D.M.E. These systems provide only cockpit indications of range and bearing from ground stations. If an air traffic controller were to estimate the position of an aircraft using these systems, he would have to do it *indirectly* by having an aircraft relay its V.O.R. and D.M.E. data to him.

2. In the sixth paragraph, the statement attributed to General Taylor is not true. The present landing interval between aircraft is not set by wake turbulence effects, but largely by procedures designed to avoid double runway occupancy (two aircraft using the same runway at the same time). The Alexander Committee asserted that it would be possible to reduce the minimum landing intervals, significantly below the present level, but still not below limits set by wake turbulence.

3. In the eighth paragraph, the inference given is that "instrument controlled landing . . . could, in principle, be automated . . . provided that every aircraft . . . carries a radio beacon." A radio beacon is irrelevant to automating instrument landings.

4. Also in the eighth paragraph, the statement that now an adequate beacon can be fitted for as little as $200 is not true. The purchase price of a new beacon transponder for the present air traffic control system is at least $500. The inference is also made in this paragraph that "a data-link between ground and air" can be fitted for as little as $200. This equipment has not yet been specified, designed, or manufactured. It has only been recommended by the Alexander Committee. The fact is that this data-link equipment will be much more complex than the present beacon transponder, and a $200 price tag is not realistic.

Thomas J. Goblick, Jr.
Air Traffic Control Division
Lincoln Laboratory
Lexington, Mass.

Mistaken Identities and Implications

To the Editor:
In reading the March, 1970, issue of *Technology Review*, I was very much amused by the GRI Computer Corporation's advertisement (*p. 69*) which took me as the head of the Electrical Engineering Department, a position now ably served by Professor Louis Smullin.

I was also disturbed by the ad itself in some other sense. Due to the rapidly changing state of the art and knowledge surrounding computers and digital systems, there has been a continuous updating of the contents of academic subjects in these fields. As a part of an overall effort of updating the undergraduate subjects in digital systems applications, I have solicited assistance from industries.

I would like to acknowledge the following generous donations given to me and our department by the following companies, in chronological order:
Hewlett-Packard Company, an HP-2115a computer.
Data General Corporation, a NOVA computer.
GRI Computer Corporation, a GRI-909 computer.
Digital Equipment Corporation, two PDP-11 computers.

The first three machines are used for 6.274, Advanced Digital Project Laboratory. The two PDP-11's will be used for 6.273, Introduction to Digital Systems.

I would like to add that a PDP-1 computer has been in continuous usage in our undergraduate education since it was donated by Digital Equipment Corporation to M.I.T. in 1961.

Francis F. Lee
Cambridge, Mass.

The author is Professor of Electrical Engineering at M.I.T.—Ed.

Four-Letter Vernacular

To the Editor:
I have been reading *Technology Review* a long time. I have come to consider it almost as significant in the process of continually attempting to be informed as daily reading of the *New York Times.*

I have always been proud of the Review. until now. I think the February, 1970, issue page 72B verbatim quotation of Mr. Albert is unsuitable for publication.

The content of Mr. Albert's thoughts may be appropriate for publication. In this case I think paraphrasing is worthy of editorial consideration. *The Tech* may choose to quote him verbatim. However, I feel it is unmistakably wrong for the *Review* to print his exact words when those words are not generally agreed upon as acceptable to the scientific and technological community and when they rub me the wrong way.

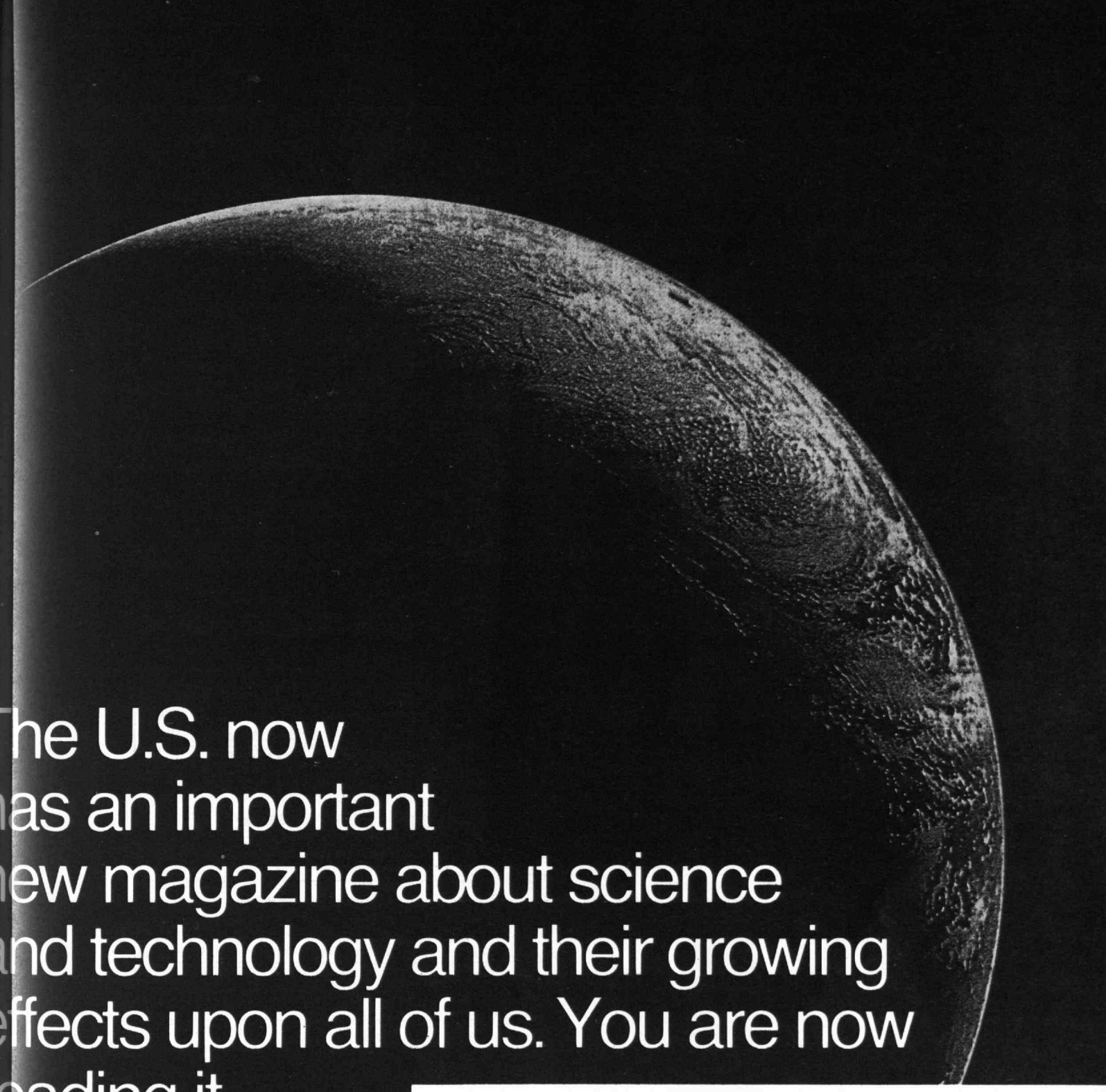
Alternative to paraphrasing, I think the *Review* could refuse to publish this man's thoughts, or any man's thoughts, until the mode of expression was up to the quality standard *Review* readers have come to expect. Communication is based upon respect. If a person has a point—and respect for his listener—he can learn to express himself well. Until he has both I do not think he deserves the *Review* medium.

Robert M. Copsey
Los Angeles, Calif.

The Review *did not lapse into the four-letter vernacular without premeditation; it was simply the Editors' decision that only by a direct quotation could they give their readers a feeling for both the spirit and the content of the subject. To those readers who find this decision offensive, our apologies.—Ed.*

April Tech-Crostic Solution

In the case of an actual population there are at least two alternative methods of experimentation to obtain data for inference or decision, namely, drawing with replacement and mixing and drawing without replacement.
—B. W. Lindgren, *Statistical Theory.*



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TR-370

Alumni Correspondence

Soviet-Style Election?

To the Editor:
Once again it is time for M.I.T. alumni to participate in the same sort of undemocratic ritual that is so common in the Soviet Union—an election with no choice. This state of affairs could be laughed off as ludicrous save for the fact that these are times of unrest and change at M.I.T., and the voice of alumni should be represented properly.

The Alumni Association elections are lacking in two respects.

First, there is no choice of candidates. An organization as far-flung and nebulous as the Alumni Association is forced to entrust a Nominating Committee with the task of choosing a slate of candidates. But this slate must offer a choice between differing viewpoints; hence, the Nominating Committee should nominate at least two (and preferably more) candidates for each office. There is no point in wasting postage money for the election in its present form.

Furthermore, since the Nominating Committee has this important task, its members should be proposed by petition of any group of 25 or more alumni, rather than simply by M.I.T. alumni clubs. Many alumni who are deeply interested in M.I.T. cannot participate in an alumni club for geographical reasons; while others, especially those working at M.I.T., may be sufficiently in touch with events at the Institute so as not to want to participate in club activities. Currently, these people are not adequately represented in selecting the Nominating Committee and, hence, have little part in the "representative democracy."

Second, even if there were more candidates nominated, the information given about them is insufficient and irrelevant to choosing people to meet current-day challenges. It is fine to learn that John Doe is President of XYZ Company and has been working for the Alumni Association for N years; but it is more important to know John Doe's views on the issues that face M.I.T. today—government research, educational diversification, coeducational living, Institute decision making, and so on. To this end it is vital that each candidate for office present a written statement of his views.

Finally, it is entirely unclear how an alumnus can go about changing this ridiculous state of affairs. There seems to be no legislative organ of the Alumni Association. Legislation should be presented and discussed in *Technology Review* and voted on by mail once a year.

James A. Rome, '64
Marvin A. Sirbu, Jr., '66
Theodore Kaplan, '66
Brighton, Mass.

The authors are Instructor and graduate students, respectively, in the M.I.T. Department of Electrical Engineering—Ed.

Toward Representative Government

To the Editor:
The recent Annual Election of Alumni Officers for 1970-71 reemphasized to me the fact that the Alumni Association is getting out of touch with younger alumni. Indeed, many recent alumni believe that it is so irrelevant that they do not even bother to fill out their ballots. I believe that the officers of the Association and the alumni nominees to the M.I.T. Corporation should represent the alumni.

Consider the 15 current alumni nominees to the Corporation, the nine members of the National Nominating Committee which nominates them, and the 15 members of the Alumni Fund Board. None of these 39 men has graduated in the past 15 years and only two have graduated in the past 20 years. Let me say that I am thankful that these men have unselfishly donated their services to M.I.T.; however, I feel that at least a minimal representation of younger alumni is needed on these bodies.

I strongly urge the Directors of the Association to take whatever measures are necessary to insure that the classes of the last 10 and 20 years are represented on the Corporation, the National Nominating Committee, and the Alumni Fund Board. Since all alumni are eligible to give money to M.I.T. through the Alumni Fund, all alumni should be represented on the committees of the Association which have a direct influence on the Institute. This is not a question of power; it is a simple question of the right to be represented.

Michael J. Marcus
Cambridge, Mass.

Mr. Marcus is Secretary of the Class of 1968.—Ed.

Plowshares vs. Destruction

To the Editor:
J. Douglas Brawner's letter to the Editor published in the January issue of *Technology Review,* (p. 99), surely does not represent the views of all alumni who are disquieted by the direction M.I.T. policies seem to be taking.

I do not think any university should be ashamed to contribute to the national defense by working on either research, design, or development of military systems. I had difficulty understanding why anyone should object to defense work until I read the editorial matter in the right hand column on page 71 of the January issue: "Because it may be able to destroy the other side's missiles as well as exhaust any intercept system (such as our proposed antiballistic missile system), M.I.R.V. gives the side possessing it enormous first-strike advantages. It thus threatens to upset the previously 'stable' situation."

In my opinion it is specious to reason that because a weapon "could" be used for a first strike, its possession by the United States implies that it *would* be so used. To assume that the U.S. would initiate an attack flies in the face of reason.

As long as the United States retains its democratic institutions and maintains its armed forces for strategically defensive purposes, I see no reason for an institution like M.I.T. to be pressured into withholding its contribution to the common defense of our country.

John D. Alden, '49
Pleasantville, N.Y.

Institute Review

"Interruption of a School"

Following a one-day trial early in April, Judge Haven Parker of the Third District Court of Eastern Middlesex on April 13 found George N. Katsiaficas, '70, and Peter G. Bohmer, '65, guilty in each of two complaints charging them with "the willful interruption of a school." These complaints were among those originated by the Institute for actions relating to the occupation of the offices of the President and Chairman on January 15 and 16 (*see* Technology Review *for February, pp. 72A-72D).*

In one case incident involving the interruption on January 16 of a class of John Wulff, Professor of Metallurgy, Emeritus, the Court imposed a sentence of 30 days in the House of Correction on each defendant; in the other incident on the same day involving a class of Dr. Edwin D. Bransome, Jr., Associate Professor of Endocrinology and Metabolism, the defendants' sentence was 30 days in the House of Correction plus a fine of $50 each.

The judge directed that the sentences be served concurrently; but he refused the defense counsel's request that the sentences be suspended.

Both Mr. Katsiaficas and Mr. Bohmer entered appeals which will be tried before a jury in the Superior Court; no date has been set.

Defense Research and Special Laboratories: The Great Debate

When President Howard W. Johnson announced that this year would be a time for testing the Institute's continued operation of two defense-oriented "special laboratories" (*see* Technology Review *for December, 1969, p. 96*), he set the stage for a year-long community debate without recent precedent in both its breadth and depth. There have been six months of faculty meetings, position papers, discussion sessions, and corridor conversations.

In the result some issues have been clarified, some muddled—and some hardly discussed in public at all. And the question which President Johnson must answer before his self-imposed May deadline remains: Can M.I.T.'s off-campus Draper and Lincoln Laboratories—established and mostly operated in response to needs expressed by the Department of Defense—diversify their research, increase their academic interactions, and continue under Institute management in a time of changing national priorities?

Three resolutions, representing the three alternatives which are now most clearly seen for the President, stand before the faculty:

1. To continue laboratory operations under M.I.T. management with continued commitment to the Department of Defense but with diversification and increased educational participation, a resolution offered by Professors Wallace E. Vander Velde, Sc.D.'56, and Walter McKay, '34, of the Department of Aeronautics and Astronautics.

2. To continue laboratory operations under M.I.T. management while eliminating programs dealing with military weapons, a proposal of Professors Bernard T. Feld and Herman Feshbach, Ph.D.'42, both of the Department of Physics.

3. To divest the Draper and Lincoln Laboratories as now constituted from M.I.T., incorporating into the Institute certain of their activities in "new goal-oriented [research] appropriate to the Institute's educational and research objectives," the resolution of Ascher H. Shapiro, '38, Head of the Department of Mechanical Engineering, and Thomas B. King, Head of the Department of Metallurgy and Materials Science.

Distorting the Purposes of the University

Summarized so briefly as to risk absurdity, here are some of the arguments on which community discussion has focussed, in the words of the debaters themselves.

On the hazards to education of large, mission-oriented laboratories:
"[A mission-oriented laboratory] is foreign to, and distortive of, the purposes of a university. . . . When one considers the heavy obligations of the "special laboratories" and the objectives of the professionals who comprise the backbones of their staffs, it is plain that students cannot be important in the scheme of things. . . . As a laboratory dominated by professionals grows beyond a certain point in size it acquires a life of its own. It becomes less and less dependent upon its association with a campus and . . . more exclusively concerned with its own future and with its obligations to its sponsors."—Professor Shapiro.

"When two ventures having different primary objectives are joined, conflicts of interest arise. . . . What is good for the Draper Laboratory is not necessarily good for M.I.T. and vice versa."—Edward S. Taylor, '24, Professor of Flight Propulsion, Emeritus.

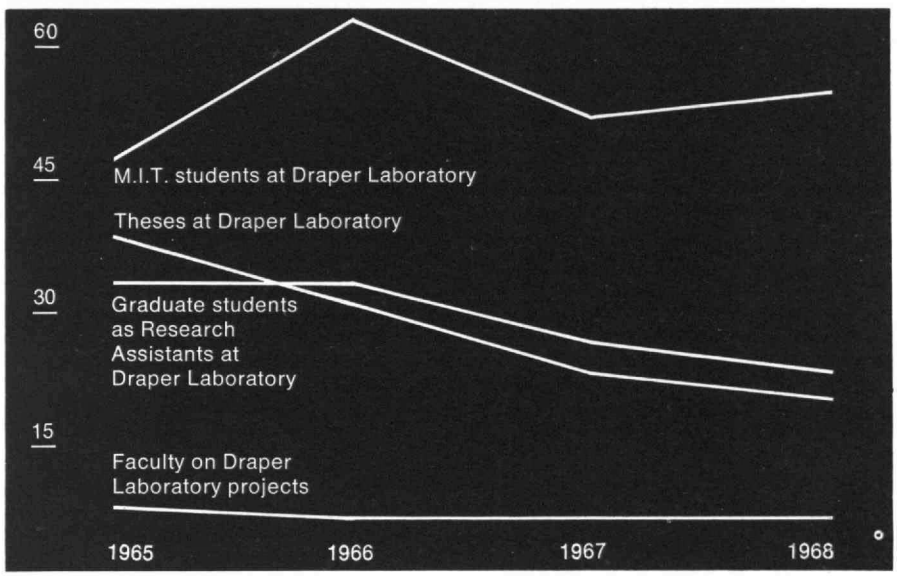
On M.I.T.'s need for the laboratories:
"If we are thinking of action on urban or environmental programs which will ultimately cost billions of dollars, then the goal-oriented research required to bring [forward a] . . . creditable demonstration which the country will implement will require tens of millions of dollars. . . . If M.I.T. chooses to spend only a small fraction of these dollars, then it must be content with a small fraction of the impact."—Milton U. Clauser, Director of Lincoln Laboratory.

On the educational value of mission-oriented research:
"It is the feeling of the faculty of this Department . . . that a large laboratory . . . is absolutely essential if meaningful teaching and research in ['systems engineering'] are to be undertaken and if students are to be exposed to actual experience with operating systems."—Rene H. Miller, Head of the Department of Aeronautics and Astronautics.

"M.I.T.'s large mission-motivated laboratories, engaged at the forefront of research and development as well as having responsibility for the engineering design of significant systems, present us with a unique opportunity to devise means of stimulating and enriching engineering education."—Professor Vander Velde.

"In his professional training, a student

Can diversification of Draper Laboratory activities offset the recent trend toward fewer numbers of faculty, graduate students, and theses there? The figures on this chart, compiled by Robert H. Scott, '64, as Assistant Dean, Administration, of the School of Engineering, show that less than 2 per cent of M.I.T. graduate theses were performed at the Instrumentation (now Draper) Laboratory in any year since 1963. Of theses completed in the Laboratory since 1963, a decreasing proportion, averaging about 15 per cent, have been classified.



must acquire both a degree of skill and a sense of professional and social responsibility; he usually does so during a period of professional practice under academic supervision. . . . Large laboratories engaged in the development and design of actual hardware under faculty supervision . . . fulfill an important function . . ."—Leon Trilling, Professor of Aeronautics and Astronautics, M.I.T.

"It is believed by many that technical schools will find it more and more difficult to provide a first-rate technical education. . . . The reason for this is that industry has larger research facilities and allocates resources for the purpose of staying at the forefront of technology; industrial research laboratories can outdo an educational institution in the quality of equipment and the immediacy of the technical problems on which they work." —Hermann A. Haus, Sc.D.'54, Professor of Electrical Engineering.

"The Lincoln Laboratory represents one more of a large number of organizations through which universities communicate with the world, keep abreast of new developments, serve the community, and offer the best in professional and scholarly training. Those of us who have been considering the possibility of a medical . . . school at M.I.T. would consider it tragic if the option of forming specialized and semi-autonomous organizations under Institute auspices were closed."—Sheldon Penman, Associate Professor of Biology.

An Impractical Distinction in Defense Research

On the fulfillment of national obligations:
"The Institute, as one of the organizations that enjoy the benefits provided by the United States, must contribute its fair share in areas of its particular capabilities to the survival and progress of our nation."—Charles S. Draper, '26, Vice-Director of the Draper Laboratory.

On defense research at M.I.T.:
"Our principal concerns regarding the role of the 'special laboratories' relate to the matter of national interest and the ways in which the laboratories can be said to serve that interest. In a period in which the enormous destruction of life and the total destruction of civilization, as we know it, are well within the military capability of the great powers, activities that are intended to increase this capability, that upset the present balance of nuclear terror and that thereby impede negotiations for arms control, can hardly be characterized as being crucial to the national interest. . . . It is essential for the welfare of the United States and perhaps of mankind that we recognize that what the Department of Defense considers good for us is not necessarily good for us, and that we act upon this insight."—Union of Concerned Scientists.

On the problems of diversification:
"I consider it unlikely that laboratories of the size of Lincoln and Draper will long be supported by the government if their activities in fundamental research are not combined with the development of systems that are suitable for operational employment. The distinction between two categories of defense research, one less immoral than the other and therefore more appropriate to M.I.T., is an expedient that will, in the long term, turn out to be unstable and impractical. It makes no sense to work toward military strength but refuse involvement with weapons."—Carl F. J. Overhage, Professor of Engineering.

"If M.I.T. dictates what the Draper Laboratory shall not do, I foresee the gradual liquidation of this laboratory. The effort to procure nonmilitary support, even if successful, will result in projects most of which are unsuited to the expertise which now exists. With the exception of the air traffic control problem, which would be a wonderful thing to get into the Draper Laboratory whether or not it remained a part of M.I.T., I see a supply of nonmilitary problems wholly inadequate to support this laboratory."—Professor Taylor.

On the laboratories' need of M.I.T.:
"University development work offers specific benefits. . . . Some advantages for the nation are: experience and proven success, new and imaginative approaches resulting from the association with the university, and the absence of a corporate relationship with manufacturing. This last in turn results in a desire on the part of the developers to work out the least expensive system since the developers are taxpayers rather than part of a corporate producer." —Samuel A. Forter, S.M.'47, Associate Director of the Draper Laboratory.

". . . The experience of the last 30 years has shown that the universities in the U.S. have done better defense research less expensively than other organizations. If we now decide to let George do

it . . . we must recognize that George won't do it very well."—Professor Overhage.

"The enthusiasm and uninhibited imagination of the students who have worked with the Draper Laboratory have added significantly to the high standard of its performance over the years. . . . There are several specific features in the design of the Apollo guidance and navigation system, for example, which were suggested and developed by students."—Professor Vander Velde.

The Imponderables

Beyond these issues lie four other less public concerns, on which a faculty vote on the three resolutions—if held—might turn:

1. If M.I.T. and the laboratories decide on diversification, would this course in fact be feasible in an era of dwindling research funds? Has this debate at M.I.T. so shaken the confidence of the U.S. government—even the Department of Defense—in the "special laboratories" that work will be sent elsewhere for reasons of security or for fear of community indifference?

2. If the laboratories do add new research directions, will the resulting contracts for the "special laboratories" come at the expense of work which might otherwise be done by academic laboratories? In other words, if they get theirs can I get mine? (Albert G. Hill, M.I.T.'s new Vice-President for Research, insists that this fear is groundless; projects of a scale suitable for laboratories such as Draper and Lincoln are simply too large for conventional academic research, he says. On the contrary, he believes such large projects at Draper and Lincoln could generate important related activities for academic research laboratories.)

3. If the laboratories do add new research directions, will this put them—and M.I.T.—in competition with private industry for funds? (The Draper Laboratory now has a capability essentially unique in the world in inertial guidance; it competes with no one in a technology which remains vital for U.S. defense. But it has no such privileged position in fields like transportation or solid waste disposal.)

4. Finally, in an era when academic expenses are increasing far faster than income, is it realistic for M.I.T. to divest itself of laboratories which generate $9 million annually in overhead, much of which helps support operations from which both faculty and students benefit?

A Systems Laboratory for Electric Power Engineering

An Electric Power Systems Engineering Laboratory has been established within the M.I.T. School of Engineering, and work is underway on a series of projects ranging from studies of new power generation methods to the effects of increasingly high voltages on transformers, circuit breakers, and other components. Herbert H. Woodson, '51, Philip Sporn Professor of Energy Processing, is Director, and the Laboratory is expected to draw participation from the Departments of Electrical, Mechanical, and Nuclear Engineering.

Raymond L. Bisplinghoff, Dean of the School of Engineering, said in his announcement of the new Laboratory that it "reflects the growing need for engineers in the rapidly expanding power industry and the challenge of problems created by the increasing complexity of power systems serving the world."

Already associated with the new Laboratory are Professors Charles Kingsley, Jr., '27, Fred C. Schweppe, and Gerald L. Wilson, '61, of the Department of Electrical Engineering. David C. White, Ford Professor of Engineering, and Herman M. Schneider, '62, will be active in E.P.S.E.L. upon their return from leaves at the end of the current academic year.

Theses completed at M.I.T. in the field of electric power during the past year include contamination flashover of outdoor insulation; computer modeling of electric power systems; alternators with superconducting field windings; effects of transformer saturation in power transmission systems; cylindrical magnetic circuit breaker; voltages induced on bodies under transmission lines; interrelation between exciter response and generator reactances; modeling exciter and steam-turbine-generator characteristics for a 600-megawatt unit; switching surge flashover model; analysis and control of power systems.

Financial support for E.P.S.E.L. is being provided by Philip Sporn, former president of American Electric Power Company, the Edison Electric Institute, and nine companies: American Electric Power Company, The Dayton Power and Light Company, Allegheny Power System, Columbus and Southern Ohio Electric Company, General Electric Company, Pennsylvania Power and Light Company, Island Creek Coal Company, Union Electric Company, and Niagara Mohawk Power Corporation.

Cambridge Housing Architect

The Cambridge architectural firm of Benjamin Thompson and Associates, Inc., has been selected to design some 700 new dwelling units for elderly and low-income groups under M.I.T.'s Cambridge housing program which was announced early in 1969 (*see* Technology Review *for May, 1969, pp. 75-76*).

The work, on three sites in North Cambridge, Cambridgeport, and East Cambridge, will represent the first phase of a program which ultimately will include construction of up to 1,600 dwelling units on five properties assembled by M.I.T. in various parts of Cambridge. Extensive discussions with citizens in the three neighborhoods during the past year has revealed a definite preference for housing for the elderly at the three sites on which the Thompson firm will work, and zoning changes necessary for the projects have been approved by the Cambridge City Council.

The schedule calls for construction to begin in about a year—"a very difficult" requirement, according to Benjamin Thompson, considering especially "the budget limits and bureaucratic requirements. But we recognize the serious housing crisis in Cambridge and will spare no effort in helping to produce these new units on time," he said, speaking on behalf of the architectural firm.

The Thompson firm is well known for residential buildings at Brandeis University, Williams College, Phillips Academy, and Colby College; for the Laurel-Clayton residential neighborhood plan in Worcester, and for low-cost urban housing units designed for the Massachusetts Housing Association.

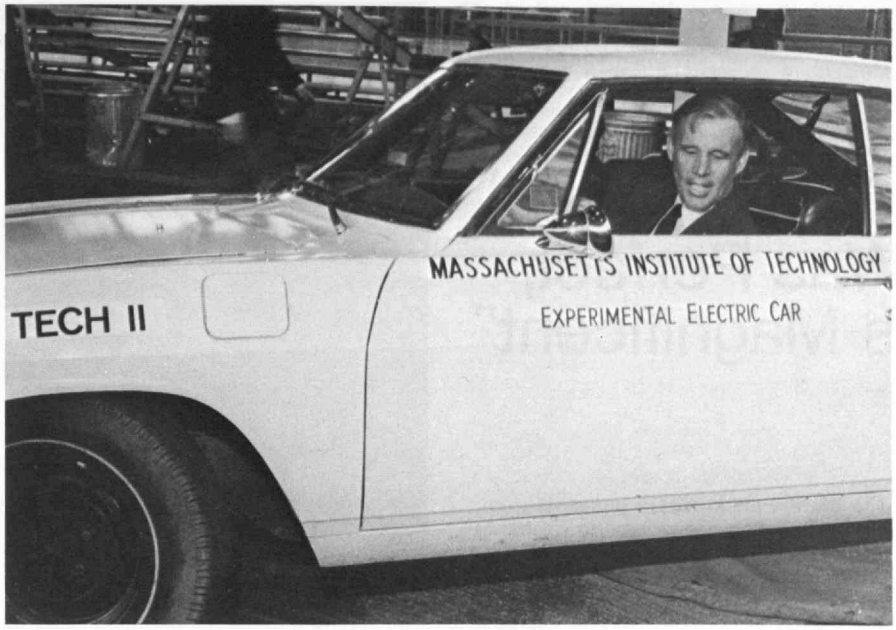
Planning is continuing for housing to be built on two other locations included in the program, in East Cambridge and on Massachusetts Ave. near Central Square.

Of "Tech II," a Nonpolluting Car, Falderal, and the Governor

Three months of test driving lie ahead of "Tech II" before it enters the 1970 "Clean Air Race" from Cambridge to Pasadena, Calif., next August, in competition with at least 30 other entrants to dramatize the country's problems in developing low-air-pollution vehicles to supplant today's automobiles.

With all the falderal of old-style press-agentry, "Tech II" was christened on February 23 by Colleen Keogh, an M.I.T. secretary who handles most of the "electric car" correspondence, breaking a bottle of "fresh" air imported from Cape Cod over the car's rear bumper, and Governor Francis W. Sargent, '39, who drove the car on a quick circle of the Rockwell Cage track while newsmen's cameras flashed.

The race—and M.I.T.'s entry in it—are a second, far more sophisticated edition of "The Great Electric Car Race" of



"Tech II," M.I.T.'s entry in next summer's "Clean Air Race" across the country, was tested this winter by Francis W. Sargent, '39, Governor of Massachusetts. He congratulated the builders—two M.I.T. students, David A. Saar, '70, and William W. Carson, '69—told newsmen that "this is the type of car that can go a long way to solving our pollution problems."

1968 (*see* Technology Review *for October/November, 1968, pp. 83-85*), when electric cars developed at M.I.T. and Caltech struggled across the country through a series of misadventures, one headed west, the other east. "Tech II," though it is the same Corvair chassis and body and carries the same "TECH" license plate as the 1968 entry, is in fact almost a totally new car.

A new 70-h.p. electric motor drives the car, powered from nearly 1,000 pounds of nickel-cadmium batteries carried at the back of the passenger compartment. In front, in the Corvair luggage compartment, are "Tech II" 's real innovations—an 18-h.p. two-cylinder four-stroke gasoline engine connected to an alternator, and sophisticated solid-state controls. The car's builders—David A. Saar, '70, an electrical engineering major, and William W. Carson, '69, a graduate student in mechanical engineering—say the alternator will in fact recharge the battery while the car is moving.

During the race, the engine will be used on the open road to keep the batteries fully charged, but it will be shut off in urban areas where pollution is a problem. Speed and power are governed by a semiconductor power control unit of unique design. Air vents have been added to the Corvair body to provide cooling for the engine and alternator and for the electric motor, where operating temperature may be the limiting factor on loading, according to the car's designers.

Instruments in the driver's compartment record the speed and current drain of the motor, the system voltage, the condition and temperature of various sets of batteries, and motor temperature; there are warning lights and a small siren to warn of malfunctions.

During testing this spring, "Tech II" will be equipped with a multitrack paper recorder to record for later analysis how each of its circuits is operating. Before time for the race, the engine will be converted to operate from L-P gas instead of gasoline, and antipollution devices will be added. Mr. Carson told reporters that, even before it is fully tuned and ready for the road, "Tech II" can travel at speeds "far enough above the speed limits so that no one cares." For how long, he didn't say. Doesn't know—yet.

Ernst A. Guillemin, 1898-1970

Ernst A. Guillemin, S.M.'24, Professor of Electrical Engineering Emeritus whom President Howard W. Johnson called "one of M.I.T.'s great teachers," died on April 6 after a brief illness; he was 71.

Professor Guillemin retired from active teaching at M.I.T. in 1966 after 52 years' service on the faculty. At the time of his retirement he had been for six years the Edwin Sibley Webster Professor of Electrical Engineering. Professor Guillemin's first appointment to the M.I.T. faculty as Assistant Professor was in 1928; he became Associate Professor of Electrical Communications in 1936 and Professor in 1944.

In his announcement to the M.I.T. faculty of Professor Guillemin's death, President Johnson said he was "one of the leaders in revolutionizing electrical engineering education and was legendary as an enthusiastic lecturer. He and his students have been among the leading contributors to the development of circuit theory and synthesis. Professor Guillemin's outstanding contribution," said Mr. Johnson, "was to shape techniques for designing electrical and electronic circuits into a rational theory and to create a generation of engineers and educators who are now leaders in their professions."

Professor Guillemin was born in Milwaukee and attended the University of Wisconsin before coming to M.I.T. for graduate study (S.M., 1924); he then received the Saltonstall Travelling Fellowship and studied at the University of Munich for the Ph.D. degree (1926).

Professor Guillemin was a member of the consulting firm of Guillemin Associates and was a founder of Guillemin Networks, Inc. He received the Medal of Honor of the Institute of Radio Engineers in 1961 and the President's Certificate of Merit in 1946 for his contributions to defense research during World War II.

A scholarship fund in Professor Guillemin's honor has been established in the Department of Electrical Engineering.

J. C. MacKinnon, '13, 1891-1970

Joseph C. MacKinnon, '13, for 33 years Registrar of M.I.T., died on March 19 after a long illness.

In his announcement to the faculty, President Howard W. Johnson noted that MacKinnon has been identified with M.I.T. for more than 50 years; he had given "devoted service" to the Institute, President Johnson said.

Mr. MacKinnon first came to M.I.T. with the Class of 1913, when he registered for undergraduate work in physics. He returned two years after receiving his S.B. degree to become an assistant and later (until 1924) Instructor in Physics. Meanwhile, in 1923 he was named Registrar, serving until his retirement in 1956, when he was named Special Adviser to the Director of Physical Plant for six years. Mr. MacKinnon became an ex-officio member of the faculty in 1929 and served as Assistant Secretary of the Faculty from 1934 to 1951. During World War II he assisted in directing the program of Engineering Science and Management Defense Training Courses conducted at the Institute.

Mr. MacKinnon was Treasurer of the Association of Collegiate Registrars for a number of years, and he was its President in 1940.

O. Reid Ashe, Jr., '70

An official account of the M.I.T. expedition to Miahuatlan, Oaxaca, Mexico, to photograph "an event of great religious significance"

"The Weather Was Perfect, the Eclipse Was Magnificent"

Many studies have been made of what happens when modern technology moves in on a traditional society. But what happens when it merely makes a social call?

This unlikely question was answered March 7 when over 1,000 of the world's scientists met in the town of Miahuatlan, Oaxaca, Mexico, for the 1970 total solar eclipse. The excitement surrounding the event created a unique atmosphere in Miahuatlan which M.I.T.'s eclipse expedition will not soon forget.

Nature chose this small, dusty market town high in the Sierra Madre del Sur mountains of southern Mexico as the best observation point for the 1970 eclipse. Of all the points on land along the path of the eclipse, this area had the best combination of high altitude, low zenith angle of the sun at totality, and long duration of totality. It also had by far the highest probability of clear skies.

Nature would have been hard pressed to make a more beautiful choice. Located in the extreme south of Mexico, Miahuatlan's environs have a rugged, primitive beauty that even the driest of scientific reports would not hesitate to call spectacular. It is an extremely mountainous area which contains a wide variety of climates within only a few miles' distance. From the mountaintops southwest of town one can see terrain ranging from cactus- and brush-filled desert to dense semitropical forest.

Less than half a dozen roads cross the rugged Sierra Madre del Sur. Miahuatlan is located on one of these, which connects the Pacific Coast town of Puerto Angel with Oaxaca, the state capital. Although Miahuatlan is less than half the way along the road from Oaxaca, it marks the end of the power lines and the end of the pavement.

Agriculture and Catholicism

By most standards, the term rustic is an understatement when applied to Miahuatlan. There are one schoolhouse, two churches, a 12-room hotel, a handful of cafes, two service stations, and one public telephone—although two extra public telephones were installed for the eclipse.

The market place where peasants from the surrounding area come to exchange their farm goods for manufactured items supports, directly or indirectly, Miahuatlan's 8,000 inhabitants. Every Monday the market overflows to clog almost every street in town with trucks, vending stands, and crowds of merchants and farmers. Although there is some mining and a great deal of tourism in other parts of Oaxaca, Miahuatlan exists solely as a local trading center.

The principal occupation in the area is subsistence farming, and most of the residents have never traveled more than a few miles from where they were born. Ever since the Spanish conquest, the bases of the local culture have been agriculture and Catholicism, and there is little evidence that the life of the peasants has changed in the past three centuries. Miahuatlan has been by-passed by the greater part of the tourist trade. Although it is in a region of magnificent scenery and beautiful weather, it has no beaches, archaeological digs, or shops to attract tourists as have many of the other towns in the region.

On March 7, however, Miahuatlan was crowded with visitors from all over the world. The scientists were not the only strangers in town; there were also hundreds of tourists, most of them from the prosperous Federal District around Mexico City, and at least as many young people, most of them on their way to a large "happening" in Puerto Angel. The road was filled with vehicles of every description, and the countryside was speckled with visitors' campsites. The Mexican television network and N.B.C. had set up equipment just outside of town for live coverage of the eclipse, and representatives of almost all the major Mexican newspapers were present as well.

The town fathers of Miahuatlan had long since realized that March 7 would be the most important day in their town's history, when it would be the focus of interest for much of the world's scientific community and for all of the Republic of Mexico. Apparently they liked the idea, for even the earliest scouting parties reported that the local officials were extremely friendly and cooperative.

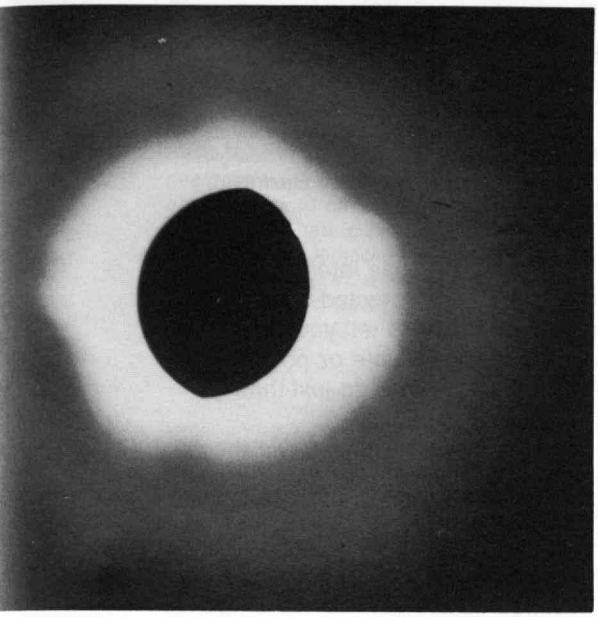
But the town's leaders did not stop with cooperation: they welcomed their visitors with a week-long series of fiestas ending with a banquet and dance the night after the eclipse. The theme of the celebration was apparent in the decorations. One of the *calendas* depicted foil-covered telescopes aimed at an eclipsed cellophane sun. A lantern gave a clever schematic representation of a solar eclipse, with the umbra and penumbra outlined in three dimensions with colored cellophane. Bands played in the square all day, and entertainment was provided on a stage in the square at night. Police and army troops directed traffic and stood by, but there was apparently never any disorder. There were unconfirmed reports that the local government had magnanimously released all the prisoners from the town jail and declared a week-long suspension of taxes.

An American girl on her way to Puerto Angel described the forthcoming eclipse as "an event of great religious significance." She explained that the old sun, which was evil, was about to die and be replaced with a good new sun.

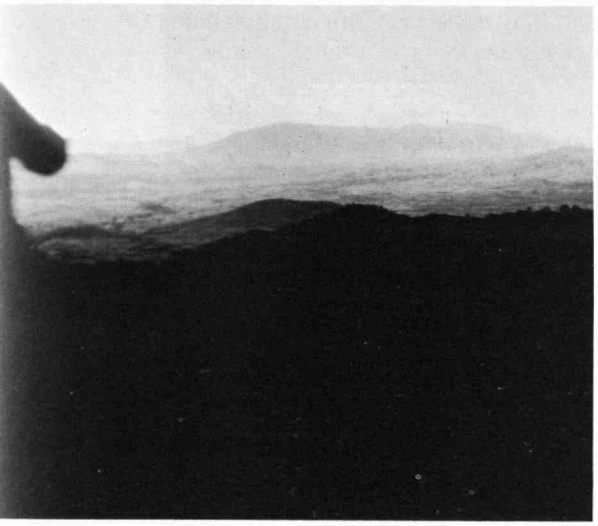
The natives had a considerably more scientific understanding of the eclipse, though. The fiesta decorations revealed an accurate conceptual grasp of what was about to happen in the sky. Furthermore, though they tended to be reticent in asking questions, the people showed an interest in the work of the scientists. Even children, understanding the need for eye protection, visited scientific camps to ask how to look at the eclipse.

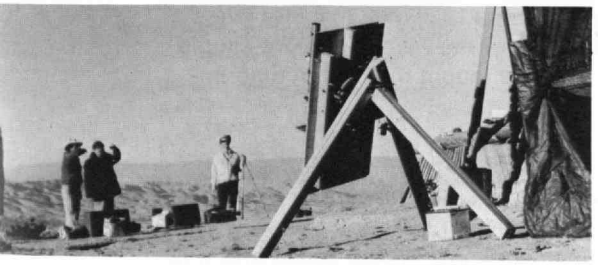
The M.I.T. Expedition

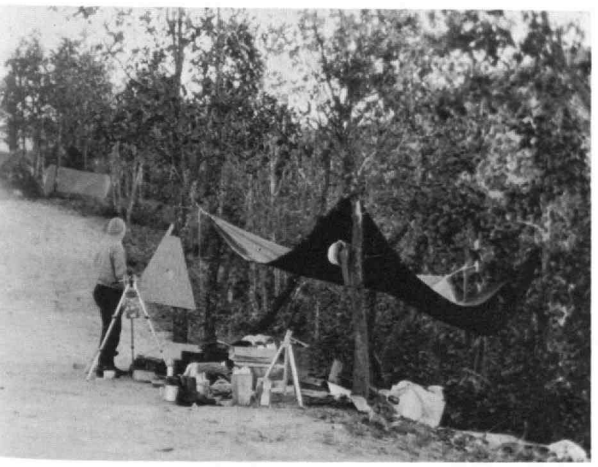
The author had arrived in Miahuatlan on March 8 as a member of an M.I.T. expedition which had left Cambridge in a gentle snowstorm one week before. James B. Altman, '71, Edward S. Gavrin, '71, and Robert T. Petriatis, '70, had built equipment for measuring the spectrum of the chromosphere when it made its brief appearance during the eclipse. (An automobile accident in Virginia the next morning deprived them of the chance; though none was seriously hurt, all were forced by minor injuries to return to Cambridge.) Alan M. Goldberg, '69, a graduate student in physics who had the role of expedition leader, Richard M.



The picture at the left may be the first ever made to show a ring of light diffracted by interplanetary particles during a solar eclipse. It is the red image from an exposure on extended-range color film used by Alan M. Goldberg, '69, on a Mexican mountain near Miahuatlan on March 7, 1970. (The oblateness of the moon is presumed the result of camera motion due to wind.) Other pictures show the moon's shadow darkening the mountaintop (but leaving distant valleys in sunshine) during totality, the students' mountaintop camp, and their tracking and other equipment admired by Mexican and American tourists. (Photos: Alan M. Goldberg, '69, Donald L. Estes, Jr. '71, and Larry-Stuart Deutsch, '67)







Koolish, '68, now a professional photographer, and Donald L. Estes, Jr., '71, were involved in three projects to photograph the corona on extended-range color and black-and-white films provided by their inventor, Charles W. Wyckoff, '41, of E G & G, Inc. (*see* Technology Review *for March, 1969, p. 39*).

Four members joined the expedition in San Antonio: E. Douglas Lewis, a student at Rice University; Michael O. Ford, a student at the University of Texas; Larry-Stuart Deutsch, '67, a medical student at McGill University, and Miss Jane Berendsen, a student at McGill. In Mexico City on March 5 the expedition was joined by Martin Diskin, Assistant Professor of Anthropology at M.I.T., and John H. Terry, '68, now an instructor in photography at M.I.T.

The group arrived in Miahuatlan early Friday morning to find the excitement intense. Everyone was drawn by the rare spectacle, and no one intended to miss it. Tourists hurried to establish camps in the mountains before the police closed the dirt road the night before the eclipse to keep down dust. Scientists conducted rehearsals of their experimental procedure and the biggest fiesta yet took place in town. Everyone seemed to realize that he was a part of a scene that would never be played again: "Enjoy it while you can" was the motto of the day.

Indeed, the show in Miahuatlan defies comparison; it cannot be reproduced at any other place at any other time on any other occasion with any other group of people. It was a huge existential circus belonging to no single group and created by no single group: the show was the audience. The natives were sightseers in their own town.

The Dramatic Fulfillment

No event less spectacular than a solar eclipse could have climaxed the excitement. The weather was perfect, and the eclipse was magnificent. The moon's shadow could be seen sweeping across the valley as the sky darkened and the temperature fell. The assembled crowds were then treated to the sight of an unusually bright corona before the sunlight came back across the valley three and a half minutes later.

For the scientists, this was the brief period of intense activity for which they had spent months in preparation. For the peasants and nontechnical visitors, however, this was the dramatic fulfillment of the promises they had read or been told of. Members of an amateur astronomy club stationed near the M.I.T. camp raised such a din of shouts that one might have thought Mexico had just won the world's soccer championship. M.I.T. students agreed that it was the most impressive phenomenon they had ever seen. (Even the fact that only two of the expedition's four cameras were operating satisfactorily during the eclipse failed to dampen the enthusiasm.) So did those in the nearby so-called M.I.T.-Beta camp—Mr. and Mrs. Peter R. Leavitt ('53) and Mr. and Mrs. George E. Peckar ('53); Mr. Leavitt had also brought samples of the same extended-range film. The textbook descriptions of eclipses could not begin to match the brilliant display in the clear Mexican sky.

When the light came back, it was essentially over. Miahuatlan went back to its business, the scientists went back to analyze their data, and the tourists went back to their homes and jobs.

But many of the scientists were wearing Mexican hats as they left, and Indian children could be seen playing with bits of aluminized Mylar.

Mr. Ashe will graduate from M.I.T. in September, 1970, in electrical engineering, and he hopes to make a career as a writer.

The Barker Library: "Pressing the Goal of Convertibility"

Following extensive renovation during the past three years, the M.I.T. Engineering Library under the Institute's main dome has been named in honor of James M. Barker, '07, former Chairman of the Board of the Allstate Insurance Co., who has been a member of the M.I.T. Corporation since 1934 and a Life Member since 1940.

James R. Killian, Jr., '26, Chairman of the M.I.T. Corporation, announced at a luncheon on March 6 that a $1 million gift from Mr. Barker had helped to make possible the new design for the library; he called the donor "a truly civilized man, an alumnus whose name we proudly perpetuate."

Mr. Barker responded with an eloquent plea for further emphasizing the humanities in technological education (*see right*).

A Laboratory Library

The new Barker Library is unique because it combines a working library with a tool for library research. For more than three years the Engineering Library has been the locale of research on library storage and retrieval systems conducted under the Institute's Project Intrex, and the Barker Library will continue as a laboratory for experiments under Intrex for improving user access to materials of all kinds. One Intrex terminal, giving access to 8,000 documents in the field of materials science through a time-shared computer program, was demonstrated to visitors during open house in the Barker Library following the dedication ceremonies on March 6.

Douglas J. Knight, Vice-President—Educational Development of RCA Corporation, emphasized the importance of such experiments in his remarks at the dedication luncheon. One of the emerging issues of the university, he said, is how "to further a living relationship between man and his sources of data." Unless we have effective means to reach into a great library, he said, its storage "may be simply the creation of a slag heap. I commend to you the question of turning information into wisdom by making libraries centers for the storage and retrieval of judgment, not simply information."

The architect for the renovation of the Barker Library was Walter A. Netsch, Jr., '43, a partner in the Chicago office of Skidmore, Owings & Merrill, in collaboration with James DeStephano and William Berrier. The design allows for traditional functioning but includes flexibility for accommodating the future results of Intrex experiments. Carl F. J. Overhage, Director of Project Intrex, said at the luncheon that Mr. Netsch's designs "pressed the goal of convertibility in the design of a dual facility—a conventional library and versatile laboratory."

The Word Is a Talisman

The following are extracts from the remarks of James M. Barker, '07, at the dedication of M.I.T.'s Engineering Library as the James Madison Barker Library on March 6:

My life-long interest in words, language, and languages has intensified my early affection for libraries. Many years ago I became interested in what I might call the *talismanic* aspect of words. I do not need to tell you that a talisman is anything whose presence exercises a remarkable or powerful influence on human feelings or actions. A word may, or *can,* do just that.

Ordinarily we take the fact and function of words for granted. We use them so constantly and so continuously for communication that their part in the thought process escapes attention. Words are the percussion caps that set off the explosions in our minds that we call thinking or reasoning. The sight, the sound, or the thought of a word activates the whole unconscious mental concept already associated with that word symbol and gets it ready to combine with other concepts similarly activated by other words, with the hopeful result that constructive reasoning to an end may issue from the combination. Libraries store the results of that constructive reasoning and hold it ready for use.

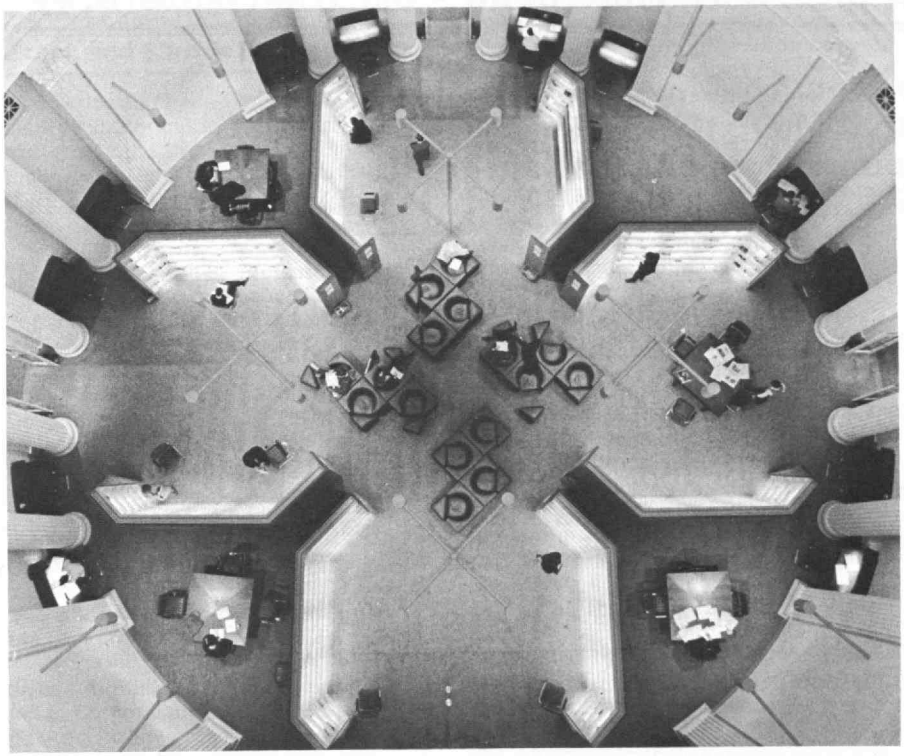
When I entered the Institute as a freshman 67 years ago this autumn, it was already a great engineering school, with a high reputation for producing engineers and scientists who were competent in their fields. The curriculum of those remote days paid little attention to the humanities. Karl Compton's vision saw the necessity of broadening M.I.T. education to include them, and he emphasized the university aspect. His successors have wisely intensified it. In an age when the proliferation of the scientific and material equipment of civilization grows by multiplication, we need to emphasize it still further, for the world's tremendous mechanical complex tends increasingly to subjugate the human element.

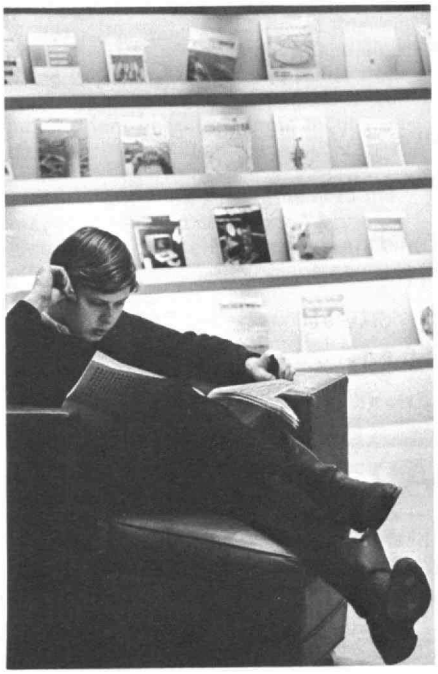
The affairs of the world have become more and more separated into two domains. On one side stands science and its relative, engineering. On the other is what I call humanistics, for want of a better term. The *principles* back of science and engineering are complex, and their real mastery takes a lifetime of strenuous effort. The *principles* back of the humanities are simple indeed. Religious leaders and philosophers have taught them from time immemorial.

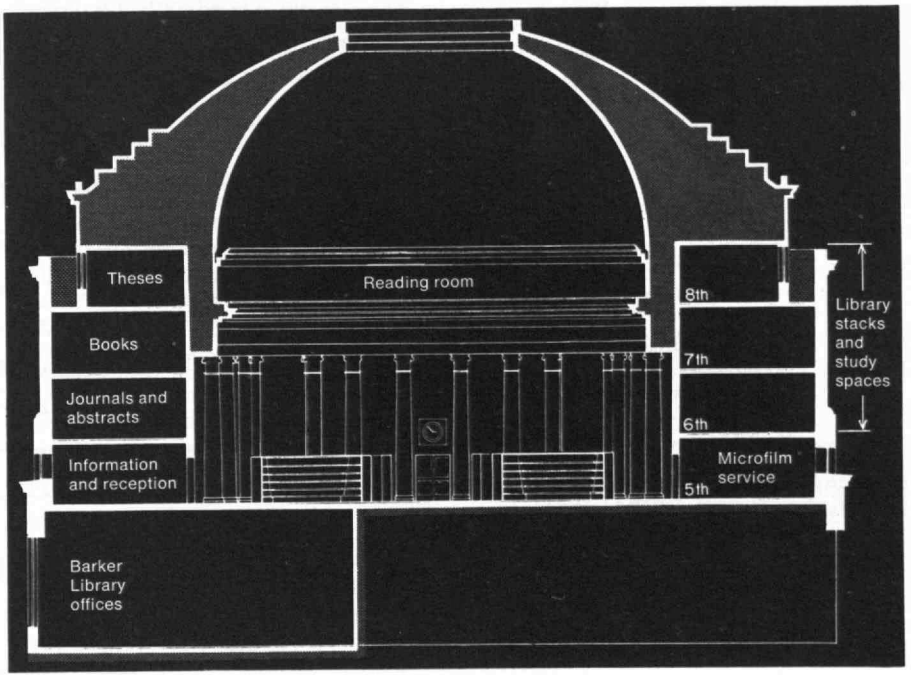
Look now at the *application* of the principles back of these two domains. In the scientific and engineering area, it may take a large measure of brains, capital, and time to put man's footprints on the moon, taking that accomplishment as an example; but the *application* is simple, in the sense that it is logical and *can* be accomplished.

Contrast this now with the humanistic domain, where the *application* of its simple principles, involving emotional human nature as it does, is immensely complex. . . . The lesson that I draw from this contrast is as follows: Scientific and engineering principles and the methods of their application are far too complex for the humanists to understand. On the contrary, the humanistic principles are easily understandable by the scientists and engineers, and *these* then are the ones who must do the understanding. *They* must comprehend and try to apply humanistic principles in all their work. It is a tough job; but as I see the future it is absolutely necessary for *them* to make the effort. . . . Increasingly our graduates must have not only the ability to apply complex scientific and engineering principles in their work, but they will understand and try to apply the simple humanistic principles in this ever more complex mechanical age.

The space under M.I.T.'s main dome has been an architect's enigma almost since it was created, as an afterthought, by architect Welles Bosworth, '89, in 1916. Now it has become the Barker Library, the collections serving the M.I.T. School of Engineering housed in new quarters designed especially to accommodate the experiments to continue under Project Intrex. It is named in honor of James M. Barker, '07, a long-time member of the M.I.T. Corporation, whose address at the dedication luncheon (photo, right) is excerpted on the opposite page.







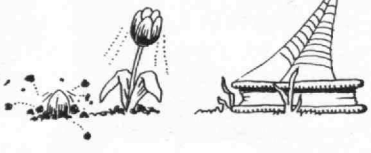
Kane on M.I.T.

Henry B. Kane, '24
Director of the M.I.T. Alumni Fund,
Emeritus

MAY 's the merriest time of all ~ old Irish proverb

Whan that the month of May
Is comen, and that I here the foules synge,
And that the floures gynnen for to sprynge,
Farewel my bok, and my devocioun.

~Chaucer



He capers, he dances, he has eyes of youth,
he writes verses, he speaks holiday,
he smells April and May.

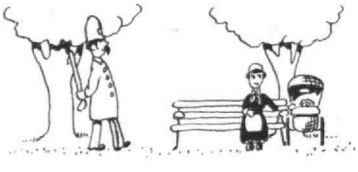
~Shakespeare

Hail bounteous May, thou dost inspire
Mirth and youth and warm desire.

~Milton

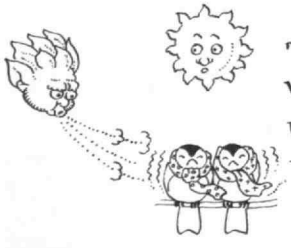
.....call me early, mother dear.....
For I'm to be Queen o' the May, mother,
I'm to be Queen o' the May

~Tennyson



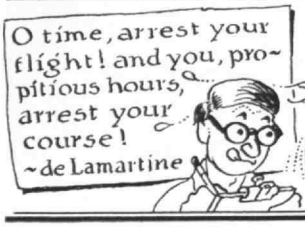
While strolling through the park one day
In the merry, merry month of May,
I was taken by surprise
By a pair of roguish eyes,
While strolling through the park one day.

~Popular Gay Nineties song



The sun was warm but the wind was chill,
You know how it is with an April day:
When the sun is out and the wind is still,
You're one month on in the middle of May.

~Robert Frost



THE INSTITUTE CALENDAR
1970

May 14....Doctoral theses due
May 21....Bachelors, Masters due
MAY 28....FINAL EXAMS BEGIN!

Cecil H. Green

R. R. Shrock

A $1.2 Million Gift for the Green and Shrock Professorships

Two endowed chairs—one in the Department of Earth and Planetary Sciences and one in the Department of Electrical Engineering—have been established at M.I.T. by a $1.2 million gift from Mr. and Mrs. Cecil H. Green ('23).

The Robert R. Shrock Professorship in Earth and Planetary Sciences is named in honor of the former department head who will retire as Professor of Geology on June 30. It is the first fully endowed professorship to be established in that Department.

At Mrs. Green's request, the second professorship, in electrical engineering, will be designated in honor of Mr. Green himself, whose M.I.T. degrees were taken in that Department. He is Honorary Chairman of the Board of Geophysical Service, Inc., and a founder of Texas Instruments Inc.

James R. Killian, Jr., '26, Chairman of the M.I.T. Corporation, called the Greens' gift "especially gratifying. M.I.T. owes its leadership to the splendid men and women who serve and have served on its faculty," he said. "At a time of financial crisis, as private universities face sharply rising costs and diminished funds from various sources, this gift speaks to our most urgent need: adequate faculty endowment," Dr. Killian declared.

The new gift adds substantially to the record of Mr. and Mrs. Green's generosity to Mr. Green's alma mater; their gift of $6 million in 1960 made possible construction of the Institute's first "skyscraper" for the Departments of Earth and Planetary Sciences and of Meteorology, later named the Cecil and Ida Green Building in the donors' honor.

Professor Shrock, who is honored by one of the two professorships, has been a member of the M.I.T. faculty since 1937, following undergraduate and graduate study at Indiana University; he was Head of the Department of Geology and Geophysics from 1950 to 1965.

Club Notes

Professor J. G. Zeitlen, '39, President of the M.I.T. Club of **Israel,** welcomed members and distinguished guests—The Honorable Mr. Haim Landau, Minister of Development of Israel and Dr. Albert Sabin, President of the Weizmann Institute—to the Club's meeting last January at the Tel-Aviv Hilton. **W. L. Abramowitz,** '35, the Alumni Council's representative for Israel, who is a member of the Board of Directors of the Weizmann Institute and an industrialist, reported on recent developments at M.I.T.

Dr. Albert Sabin then outlined his ideas about advancing science and technology in Israel. He emphasized the vital role of mission-oriented research, and the importance of close cooperation between the researcher and industry, which is the client for the product of his research. Dr. Sabin reported the creation of a high-level task force at the Weizmann Institute which has taken upon itself the role of studying various proposals for projects in what is usually called applied research, and the creation of a set of priorities for supporting such projects.

Mr. Landau, speaking of his plans for supporting research, stressed the importance of creating an atmosphere in which researchers can be creative. Such an atmosphere, said Mr. Landau, is one of the most important conditions for convincing Israeli scientists who have been abroad for many years, as well as scientists of other nationalities, to come to work in Israel. Mr. Landau promised that his office would support any effort aimed at creating such an atmosphere, as well as at defining the needs of the country in science and technology. Mr. Landau also stated that he has been looking for qualified people in various fields as advisers in his Ministry.

Bill Abramowitz then reported on a program to bring graduate students of the Department of Chemical Engineering at M.I.T. to a practical training course in Israel, probably at the Dead Sea Works. This is proposed to be part of the program of the M.I.T. School of Chemical Engineering Practice in which students presently spend a term at two field stations in U.S. chemical industries, supervised by members of the Institute staff. Those present voiced full support of the idea, and it was decided that the Club lend all help to the project.

The M.I.T. Alumni Club of **Western Michigan** held its first meeting of 1970 on March 11. This luncheon meeting at the Peninsular Club in Grand Rapids served as the kickoff for their Alumni Fund drive for this year. Special guest at the luncheon was Jeff Ingram, '58, of the M.I.T. Alumni Association.

The Club plans to have a lobster cookout in the early summer. Ham Johnson, '41, offered to coordinate the function. An attempt will be made to draw in alumni from nearby cities in western Michigan.

M.I.T. Professor of Food Toxicology Gerald N. Wogan spoke on his specialty at the M.I.T. Club of **Fairfield County**'s Westport dinner meeting on March 24. Professor Wogan reviewed briefly the programs of his department in the area of food safety, especially as these are related to current problems such as cyclamates and MSG. He then progressed to a somewhat more detailed discussion of his current research program, a field study his department has been conducting in Thailand over the past three years. The study may link dietary contamination by mold-produced toxins with liver cancer in humans.

Alumni Calendar

Boston—May 14, Thursday, 12 noon—Luncheon meeting, Aquarium Restaurant. Speaker: Halsey C. Herreshoff, '60, Yacht Designer. Topic: Yacht Design and Racing.

Cambridge—May 28, Thursday—Annual meeting of the Association of M.I.T. Alumnae, M.I.T. Student Center. Speaker: Leon Trilling, Professor of Aeronautics.

—June 12-14, Friday, Saturday and Sunday—Class Reunions.

—June 14-15, Sunday and Monday—Homecoming.

Chicago—June 9, Tuesday, 6:30 p.m.—Dinner meeting, French Room, Drake Hotel. Guest of honor: James M. Barker, '07, Director of Allstate Insurance Co. and M.I.T. Corporation Member, to be introduced by Dr. James R. Killian, '26.

Columbus—May 7, Thursday—Dinner meeting. Speaker: Professor Herbert Woodson, '51, Director of the Electric Power Engineering Lab. Topic: M.I.T. Today.

Fairfield County—May 20, Wednesday, 6:30 p.m.—Dinner meeting, Shorehaven Country Club, Norwalk. Speaker: John J. Frey, Director of F.A.S. International, Inc. Topic: Mail Order Learning.

Hartford—May 16, Saturday—Family outing at Old Sturbridge Village, including buffet lunch at 1:30 p.m. at the Village Tavern and a guided tour of the village by Edward H. Moll, '24.

Los Angeles—May 26, Tuesday—Dinner meeting. Speaker: Dr. Hans Lukas Teuber, Head of Department of Psychology.

New York—May 16, Saturday, 12:00 noon—Meeting of the Association of M.I.T. Alumnae at the Princeton Club.

Northern New Jersey—May 20, Wednesday—Annual dinner meeting. Speaker: Dr. Irwin W. Sizer, Dean of the Graduate School. Topic: Molecular Medicine.

Philadelphia—May 9, Saturday, 6:30 p.m.—Dinner meeting, Wilmington Country Club. Speaker: Glenn C. William, '42, Professor of Chemical Engineering. Topic: Problems of Pollution.

No one else can take his place, and so the committee for the 1970 Alumni Homecoming at M.I.T. went back to Arthur Fiedler, Conductor of the Boston Pops. The result: a special concert for alumni in Symphony Hall on Sunday evening, June 14, as the opening event of the two-day back-to-M.I.T. celebration. Here with Mr. Fiedler are Wallace P. Boquist, '54, Deputy Chairman (left) and Charles F. Langenhagen, Jr., S.M.'58, Chairman of the 1970 Alumni Homecoming Committee.

Pittsburgh—May 6, Wednesday, 6:30 p.m. —Alumni Award Dinner, Hilton Hotel. Guest of honor: Irving H. Wilson, '11, Director of Alcoa, and M.I.T. Corporation Member. Dr. James R. Killian, '26, will make the presentation.

Richmond—May 8, Friday, 6:30 p.m.— Annual dinner meeting, Country Club of Virginia.

Seattle—May 28, Thursday—Dinner meeting. Speaker: Dr. Hans Lukas Teuber, Head of Department of Psychology.

Tampa—May 6, Wednesday, 6:00 p.m.— Annual dinner meeting, Seminole Lake Country Club.

Deceased

George H. Leach, '00, March 17
George W. Otis, '07, April 1
Fred P. Blair, '09, February 13, 1969
Morris W. Hedden, '10, February 25, 1968
James B. Noble, '10, October 3, 1960
Carroll A. Sutherland, '10, June 25, 1968
William V. Schmiedeke, '12, November 4, 1969
Joseph C. Mac Kinnon, '13, March 19*
Alfred H. Clarke, '15, September 13, 1969
Helen S. Wasgatt, '16, March 30
Maurice L. Hodgson, '17, January 17
William T. Johnson, '17, June 5, 1969
George H. Richards, '18, January 4
Isidor Slotnik, '19, October 6, 1969
Arthur W. Rouse, '20, January 27
Webster Kimball Ramsey, '21, January 30*
Harry Rosenfield, '21, January 28*
Henry S. Dimmick, '22, November 20, 1969
Leslie D. Price, '22, June 13, 1969*
W. Harold Donnelly, '23, August 26, 1969
Kilburn M. Smith, '23, August 15, 1969*
Alfred H. Dolben, '26, September 5, 1969
Wilbur P. Foote, '34, August 4, 1969
Edmond H. Guerin, Jr., '35, March 30, 1969
Kenneth G. Holdom, '35, May 20, 1969
John M. Gray, Jr., '39, February 1*
Albert C. Rugo, '39, April 13
Peter R. Lackner, '40, January 20
Richard S. Mabee, '40, May 28, 1969
Andrew G. Cade, '58, February 19
John L. Roberts, '59, November 24, 1969

Homecoming: "Arts Fest," Pops, the Moon, and Political Activism

M.I.T.'s annual Alumni Homecoming ("Alumni Day") events begin early this year, and innovations will combine with the traditional throughout the two-day period on June 14 and 15. By May 1 a record number of alumni had made early reservations, and the committee was predicting a sell-out of the most popular events.

Alumni will be arriving on the campus throughout the day on Sunday, June 14, when an "Arts Fest" opens at 3 p.m. A student drama group is now selecting the contemporary play which they will present at that time in Kresge Auditorium Little Theater under the supervision of Joseph D. Everingham, Professor of Literature. An hour later a faculty group drawn together by Klaus Liepmann, Professor of Music, will present a concert of 20th century music in the main auditorium of Kresge.

The "Arts Fest" continues on Monday with exhibitions of photography and design by M.I.T. students and faculty; an exhibition of art books from the M.I.T. Press; open house at the Center for Advanced Visual Studies under the direction of Gyorgy Kepes, Professor of Visual Design; a film program called "Cinemagraphics," a representative showing of recent motion pictures by M.I.T. students and faculty under the direction of Richard Leacock, Visiting Professor in the Department of Architecture; and a narrated slide presentation on the impact of M.I.T. on architecture, planning, and art throughout the world.

Technology will come into its own on Monday, June 15, with morning and afternoon programs focussing on world problems and M.I.T.'s role in their understanding. The subjects and speakers include: "Prospects for World Order in the 1970's," Lincoln P. Bloomfield, Professor of Political Science; "The Earth and the Moon," Frank Press, Head of the Department of Earth and Planetary Sciences; "Air Pollution Control—the Decade Ahead," James A. Fay, S.M.'47, Professor of Mechanical Engineering; and "Lincoln Laboratory—Some New Directions," Walter E. Morrow, Jr., '49, Assistant Director of Lincoln Laboratory.

Following the traditional luncheon at which Howard W. Johnson, President of M.I.T., will give his annual report to the alumni, M.I.T. laboratories will open their doors to visitors alumni visitors. Among the projects on display will be the new M.I.T. electric car *(see page 00),* the Artificial Intelligence Laboratory, the M.I.T. Towing Tank, the Information Processing Center, and the Sensory Aids Center.

Student affairs at M.I.T. will be the subject of a second series of afternoon presentations, following a discussion in the morning of "The Ecology of M.I.T." by Dr. Benson R. Snyder, Dean for Institute Relations. J. Daniel Nyhart, Dean for Student Affairs, will lead a student panel discussing such issues as "Changing Living Styles," "The Drug Situation at M.I.T.," "Political Activism," "The Discipline Problem," and "Interactions in the M.I.T. Community."

The social events of Alumni Homecoming begin with an international buffet in the M.I.T. Student Center from 5 to 7 on Sunday evening. From there buses will take visitors to Symphony Hall for a special "M.I.T. Night at the Pops" with Arthur Fiedler conducting: this is the highlight event of the weekend, and early reservations are advised.

Following a special "surprise" event on Monday afternoon, Alumni Homecoming will close with a traditional social hour in the du Pont Gymnasium.

Members of the Alumni Homecoming Committee include Bradford Bates, '59, S. Martin Billet, '48, Wallace P. Boquist, '54 (Deputy Chairman), Armand L. Bruneau, '38, Richard E. Chambers, '53, Gary Dischel, '57, Fletcher Eaton, '49, Marvin C. Grossman, '51, Charles F. Langenhagen, S.M.'58 (Chairman), Susan E. Schur, '60, L Dennis Shapiro, '55, and Clinton H. Springer, '45.

A registration form for Alumni Homecoming is printed on the opposite page.

Use this form to register for

Alumni Homecoming

Number			Amount
	Sunday, June 14		
_____	International Buffet	@ $4.50	$_____
_____	Tech Night at the Pops*		$_____
	Monday, June 15		
_____	Luncheon and social hour	@ $7.50	$_____
		Total	$_____

* Tickets for Tech Night at the Pops are $6 for table seats on the orchestra floor; $5, $4, and $3.50 for first balcony seats; and $3 and $1 for second balcony seats. Overnight dormitory accommodations are available for reunion classes. Check here for further information ☐.

Name _____ Class _____

Address _____

Guests' names _____

Make checks payable to M.I.T. Alumni Association; send this form to the Alumni Association at Room E19-439, M.I.T., Cambridge, Mass., 02139

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30 DAYS $1649

1970 will mark the sixth consecutive year of operation for this fine tour, which offers the true highlights of the Orient at a sensible and realistic pace. As a special attraction, spring and summer departures will include a visit to the **"EXPO 70" World's Fair** in Osaka. Twelve days will be spent in **JAPAN,** divided between **TOKYO,** the **FUJI-HAKONE NATIONAL PARK,** and the ancient "classical" city of **KYOTO,** with excursions to **NARA** and **NIKKO.** A further highlight will be a comprehensive visit to the famous ruins of **ANGKOR WAT** in Cambodia, together with visits of 4 to 5 days in **BANGKOK** and **HONG KONG** and a shorter visit to **SINGAPORE.** Optional pre and post tour stops may be made in **HONOLULU** and the **WEST COAST** at no additional air fare. A complete program of sightseeing will include all major points of interest. Features range from a tour of the canals and floating markets of Bangkok and an authentic Javanese "Rijsttafel" dinner in Singapore to a launch tour of Hong Kong Harbor at sunset and a trip on the ultra-modern 125 mph express trains of Japan. Most tour dates include outstanding seasonal attractions in Japan, such as the spring cherry blossoms and beautiful autumn leaves and some of the greatest annual festivals in the Far East. Total cost is **$1649** from **California, $1828** from **Chicago, $1899** from **New York.** Special rates from other cities. Departures in March, April, June, July, September and October, 1970.

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This original itinerary explores in depth the magnificent scenic, cultural and historic attractions of Greece, the Aegean, and Asia Minor—not only the major cities but also the less accessible sites of ancient cities which have figured so prominently in the history of western civilization, complemented by a luxurious cruise to the beautiful islands of the Aegean Sea. Rarely has such an exciting collection of names and places been assembled in a single itinerary—the classical city of **ATHENS;** the Byzantine and Ottoman splendor of **ISTANBUL;** the site of the oracle at **DELPHI;** the sanctuary and stadium at **OLYMPIA,** where the Olympic Games were first begun; the palace of Agamemnon at **MYCENAE;** the ruins of ancient **TROY;** the citadel of **PERGAMUM;** the marble city of **EPHESUS;** the ruins of **SARDIS** in Lydia, where the royal mint of the wealthy Croesus has recently been unearthed; as well as **CORINTH, EPIDAUROS, IZMIR** (Smyrna) the **BOSPORUS** and **DARDENELLES.** The cruise through the beautiful waters of the Aegean will visit such famous islands as **CRETE** with the Palace of Knossos; **RHODES,** noted for its great Crusader castles; the windmills of picturesque **MYKONOS;** the sacred island of **DELOS;** and the charming islands of **PATMOS** and **HYDRA.** Total cost is **$1299** from **New York.** Departures in April, May, July, August, September and October, 1970.

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Class Review

Copy for this issue of *Technology Review* was due from your Secretary about March 23. News reaching him after that date will appear in the June issue.

95

Since communication between **Luther Conant** and me seems out of the question, it leaves not much for me to report about the two living members of 1895!

However, I have survived the winter and am looking forward to spring when mother nature comes alive in all her beauty, renewing our faith. So I am looking forward to enjoying her in all her beauty even at my "young" age of 96 years and 5 months. Good Luck!—**Andrew D. Fuller,** Secretary, 1284 Beacon St., Brookline, Mass. 02146

96

The New Year brought a note from **William E. Barbour,** Course VI, who now resides in Berryville, Va. Just now the apple blossoms must be coming into full bloom and if any of you have visited that section of Virginia in the spring you know what a beautiful sight his neighborhood must be. In the cold of winter, however, he forsook it for Florida. His family keeps him interested in and in touch with Boston, where his son Bill resides with his family, and New York where another son, Milton, is an attorney. Three daughters, two granddaughters and a grandson complete the family circle.

When I receive such handsomely written letters from you, I wish the fine art of writing had not been lost in present-day schooling. The class of '96 puts the class of '74 to shame!—**Clare Driscoll,** Acting Secretary, 11 Cliff St., Plymouth, Mass. 02360

03

My news assumes an unusual trend this month—reminiscence of our daily tasks and trials about Rogers during 1900.

Due to the passing of a devoted friend and alumnus of 1895, I was given by a thoughtful relative of his many souvenirs that provided a fund of familiar data concerning our daily presence about Rogers, Walker and Engineering and Architectural Buildings in Trinity Place which were then devoid of present modern structures and homes.

The Graduation Exercise Program was a modest 17-page leaflet, noting that the assembly took place in Huntington Hall at 3:30 p.m., May 28. There was also a large brochure, finely illustrated, with Forward: "To portray many interesting features of the Massachusetts Institute of Technology in 20 views, direct from photographic negatives and executed in the most artistic manner. To the students, a pleasing presentation of familiar subjects in souvenir form. To others, a limited view of the laboratories and work shops of this celebrated institution of technical learning."

The 25th anniversary of the class was celebrated by a 193-page volume which had a specially designed cover. The book included photographs of all classmates in present and past appearance, accompanied by biographical notes of their employment.

In conclusion, some facts seem of particular interest: the endowment of the Institute was $589,800; President Eliot of Harvard was Professor of Chemistry at the Institute from 1875 to 1879; when the Institute was 10 years old it had 90 graduates, but when less than 30, it had more than 1,000 graduates; 54 per cent of the students lived within walking distance of the Institute, 19 per cent lived in the immediate suburbs.—**John J. A. Nolan,** Secretary-Treasurer, 13 Linden Ave., Somerville, Mass. 02143

05

Just a preliminary report on the answers received from the questionnaire in regard to our 65th reunion. Most of the answers are from those whom I feared would be unable to come. Their answers, "Sorry but I just can't make it." One supreme optimist, **Sam Seaver,** after quite a story telling why he cannot make it this year, ends with: "We will look forward to 1975. I'll be only 94 then, but that will not prevent my meeting my old buddies then." Distance seems to be a great preventative. I am glad to hear that **Hal Robbins,** Grace and **Roy Allen, Art Manson, Herb Bailey** and **Errett Graham** are in sufficiently good physical condition to have said "Yes" if it were to be held several thousand miles nearer.

Now it is time to hear from those from whom I expected to hear favorably. The answers to the questionnaire are not immediately binding, but are necessary to help the committee to decide on the type of reunion desired. Give, please.

News is still scarce. Bernice and **Leonard Cronkhite** are at their favorite haunt in Green Valley, Ariz., writing and enjoying their garden spot. . . . **Gil Joslin** is still enjoying "a quiet life in Florida." His post card intimates that he might settle there for good—Seminole Hotel, Winter Park, Florida.

Gilbert Tower has been in the hospital for quite a spell recently, getting therapy for severe attacks of arthritis, but reports considerable relief. . . . **Warren Wells'** wife Hazel reports that she and Warren are "so-so," but unable to attend the June reunion. They are hoping that any '05 people visiting Florida will look them up at 601 Lantern Lane, Orange City, Fla. 32763.—**Fred W. Goldthwait,** Secretary, Box 32, Center Sandwich, N.H. 03227; **William G. Ball,** Assistant Secretary, 6311 Fordham Plaza, Bay Shore Gardens, Bradenton, Fla. 33505

08

In reply to several letters that I have written to members of our Class, **Charles L. Lufkin** of Wyandotte, Mich., a graduate in chemical engineering, retired and wintering on Treasure Island, Fla., gives the following: "My activities since graduation have been quite varied. I took a job in the southern part of Puerto Rico making raw sugar for the first year. My next work was the construction of a plant that had to be built as the result of a law suit between a weaving factory and a wool scouring outfit that dumped wool grease into the river thereby polluting it. I think the lanolin recovered about paid for the plant. I left there because of trouble caused by dating a relative of the man who brought the suit. My next position was with a plant, making chlorine and caustic soda by electrolysis; that was in Wyandotte, Mich., where I now make my

home. When WWI started I went to California to help build the same kind of plant.

"While in these plants I became interested in the use of the byproduct hydrogen in hardening soft oils. That put me into the oil business, such as cotton seed, soya, and coconut for making shortening and fish oils for use in making soap. This took me down through the south into Texas. Due to illness in the family I had to return north and made a connection with a lithograph company in Detroit. The job consisted of paper controls, ink making, and preparation of chemicals used in the process. That brought me up to the time of retirement, giving me a variety of work that was interesting as well as educational. I am sorry that I have not been able to be present at any of the alumni meetings but have always been interested in hearing about them."

J. W. Maxwell of 2734 Silver Ave., El Paso, Texas, a graduate in metallurgy and material science reports: "After graduation I went to Arizona with the Phelps Dodge people for several months, then to Chili Copper Co. At the time of WWI I returned to the U.S. to work with several small mining companies, ranging from Idaho to Texas and California. Then I took a position with The American Smelting and Refining Co. doing testing work at several of their plants in Utah. Finally I was sent to Mexico to install dust recovery operations at a couple of their smelting plants. After getting them going I took charge of several of their units and was made General Manager of the Mexican Smelting Department. After serving several years in that capacity was loaned to the Metals Reserve Co. in Washington to help in the preventive buying of Latin American metals to keep them from going to Japan. When we went to war with Japan I returned to my job in Mexico for a short time before reaching my retirement age. Due to rather poor physical condition I have not undertaken any work harder than the care of the lawn.—**Joseph W. Wattles, 3rd,** Acting Secretary, 1508 Casey Key Rd., Nokomis, Fla., 33555

09

In the December *Review* we included a letter from **Florence Luscomb** to Ray Wilson giving the history of her very active life. That she still continues her activities in behalf of social welfare is evidenced by two recent letters in Boston papers. In the *Boston Herald-Traveler* her letter is titled "Busing a Blessing in Rural Areas." She states: "Those who argue that busing of school children in order to bring about integrated schools would be an intolerable evil are ducking existing facts. In rural districts throughout the land hundreds of thousands—probably millions—of children have for years been bused to school. For scattered country children in many places this means miles and miles of riding, as compared to the relatively short distance that integration of city schools would require. Let's get over the hypocrisy that busing is a blessing when it brings good education to white children, but is an intolerable menace when it guarantees educational equality to black children." In the *Boston Globe* Florence is one of three who submitted a letter titled "Laos: a warning." It begins: "We got into the catastrophe of the Vietnam War step by step. First we provided arms and money to one side in a civil war. Then we sent in 'advisers' to train that side's forces. Next these 'advisers' began to participate in the fighting. Finally we entered into full scale war with infamy and catastrophe to us and ruin and genocide to the Vietnamese people." The letter goes on to say that we are doing the same thing in Laos and if the American people do not want to see a third of a million American boys killed or wounded, they must demand of Washington that this madness stop NOW.

We have received the following note from **Henry Spencer:** "Last November, having sufficiently recovered from a hip operation done in 1968, I was able to walk with only a cane so Madge and I joined some friends on a Caribbean cruise. Sailing from New York, November 5, our first stop was Martinique, then Barbados, Trinidad, Grenada, St. Thomas, and Puerto Rico. It was very enjoyable and I was glad to be able to move around, although temperatures close to 90° on shore did not encourage walking. Returning to New York November 19, we were met by our youngest son Richard (M.I.T. '49) who took us to his home in Philadelphia where we stayed a few days before returning to Winchester." We are all glad that Henry's operation has been successful and that he and Madge were able to go on a cruise. Madge continues to be active in the Winchester Smith College Club.

Roy H. Allen, '05, reports the death of **Francis Soderstrom,** 81, on January 24 in Phoenix, Ariz., where he lived for the past 18 years. Francis prepared for the Institute at the Mechanic Arts High School and was awarded degrees in both civil and mining engineering. He was a member of the Mining Engineering Society and the M.A.H.S. Club. Most of his life was devoted to mining engineering, principally in Arizona. He had retired as chief engineer at the Phelps Dodge Copper Queen Mine in Bisbee and was a senior life member of the Bisbee Masonic Lodge, the Sciots and the Shriners, and a veteran of World War I. Survivors include his wife, Louise, two daughters, Mrs. M. M. Nichols of Livermore, Calif., and Mrs. Frank See of Phoenix, and eight grandchildren. We have written to Mrs. Soderstrom expressing the sympathy of the class as well as our own.

Fred P. Blair died on February 13, 1969, at St. Louis, Mo. Our records show that he attended the Institute during the freshman and sophomore years and that he had lived in St. Louis since 1916.

James Nye Ryman died on November 25, 1969, in Houston, Texas. Our records show that he attended the Institute only in the sophomore year and that he had lived in Texas at least since 1924.—**Chester L. Dawes,** Secretary, Pierce Hall, Harvard University, Cambridge, Mass. 02138; **George Wallis,** Assistant Secretary, Wenham, Mass.

10

The 60th reunion is now well organized and **Jack Babcock** will be in touch with various members of the class who live around Boston who we know are going to attend this reunion. The following is a note I received from Jack stating the number he expects to attend: "Thought you might be interested in the postcard replies from our preliminary reunion notice. To date, we have 'Expect' to come from 28 classmates (including wives and guests), 'Hope' to come from 8 classmates (including wives and guests), making a total of 36. Several, however, who sent in 'Hope' to come cards are from classmates who have not attended any of our reunions (at least not within the last 20 years) so I rather doubt whether they will all attend. I have heard from all but two, now living, who attended our 55th (no reply yet from Wallour and Bill O'Hearn). The only 'No' cards in this group so far were from Bierer and Roy Briggs (health reasons). At present my best guess is that we will have between 30 and 35 classmates, including wives and other guests—compared with about 38 at our 55th. Not too bad."

Last week I received a letter from **Allen Gould** and I imagine he will be at this 60th reunion as he attended pretty nearly every other one. Allen writes as follows: "In going over my desk the other day I came across the envelope I am using, all addressed to you and dating back to the times when first class postage was only 3 cents, so I will make use of it. I just received the March *Technology Review* and note that you have me down as hoping to attend 1910's 60th. That is still true though there are a couple of possible conflicts at this end. . . . I recently dug out our 'Senior Portfolio' and the 1910 *Technique* and am surprised how well I remember the ones I knew. We just got back three weeks ago from a Caribbean Cruise on the new *Hamburg* and had an appointment to get together with **Harold Lockett** on Barbados but we missed out at the last minute. Have had a nice correspondence with him stirred up by an exchange of Christmas cards two years ago. Saw him last in France in WW I. . . . Am looking forward to seeing the Old Timers, particularly you."

Harold A. Smith sent the following note: "Alfred Hague recently called me regarding the 60th reunion. This is the only contact I have had with a member of the 1910 Class for some time. I hope to get to Cambridge for the reunion but am not sure at this time."

Personally I feel that **Carl Sittinger, John Barnard** and **Phil Harris** will attend this reunion. I expect to call them by phone

and tell them what they will be missing if they do not come.—**Herbert S. Cleverdon,** Secretary, 112 Shawmut Ave., Boston, Mass.

11

The following is **Suren Stevens**' story of his professional career: "In my senior year at Tech I was impressed by the statement made by our instructor in structures, Professor Charles M. Spofford: 'When you get out to work, do not expect to do designing; it is best to learn the fundamentals of structural details. This you can do by spending some time in a fabricating shop—first as a detailer, and then advance to a checker of details. It may take you 10 years, but you will find it will pay you as a designer.'

"I followed his advice and worked in various fabricating shops in Philadelphia, Buffalo, Massillen, Beaver Falls, Pittsburgh and Barberton.

"After working in Barberton, Ohio for Babcock & Wilcox Co. on six-inch shells for the French government, I went to New Castle, Pa. for the Carnegie Steel Co. at the beginning of the First World War. In this plant there were three blast furnaces. I worked on the design of a sintering plant—the first of its kind in this country. The process converted iron ore dust into briquets to feed into the blast furnaces.

"My next job was with Koppers Co. in Pittsburgh, Pa. After a year I returned to Boston and worked with Stone & Webster from 1922 to 1926. My next job was with E. N. Pike, Consulting Engineer. While with E. N. Pike in March 1928 I was loaned out to Dwight P. Robinson, engineering firm from New York City who designed the North Station Development (Boston Garden).

"The stock market crashed in September, 1929, followed by the great depression; jobs were non-existent. I got a job, however, with the Works Project Board in 1931 and was placed in charge of investigating all of the fire houses in Boston. With the old horse-drawn fire engine the wooden floor was within the law; however, with the new fire apparatus, the law required the apparatus' floor to be fireproof material (concrete). My squad of designers went out and measured all the fire houses and designed the floors for reinforced concrete over steel stringers. We discarded three of these houses as being unfit, due to faulty walls. Of all the houses designed, only one was changed —Ladder 3 in Charlestown. This job lasted two years, after which I joined the W.P.A.

"At the end of this project the depression was still with us. I then joined with several men who, like myself, were not employed and were interested in the stock market—mostly charts—and we formed the Securities Research Corp. We charted 150 stocks, published it once a month and sold it to investors. It took two years' research to compile all the data, for we went back two years. Considering the depression, these charts were a success. We then took 100 leading companies on the stock exchange and plotted the income-expenditure, etc., in chart form. We endeavored to sell to banks, investment counsellors, etc., most of which, however, were cutting down on their expenditures, so we lost out on this expensive project. After three years our printing bill came to $10,000 which we could not meet, and Spaulding-Morse took over.

"In 1940 I went to work with Stone & Webster for the third time, and stayed until I retired in March, 1953. During this time the Second World War had begun and our company became a part of the Manhattan Project. Those of us working on that project were under strict surveillance: we were finger-printed before working; guards were stationed on each floor; no one was allowed to enter or leave the room with anything. The rigidity of this surveillance is evidenced by the following incident: A waste paper truck came one day and removed some bales of paper. Having used the rear elevator, the man had not notified the front guard and neglected to get permission to take the paper away. The police were notified and the truck was located in East Cambridge and made to return the bales. We spent two years on this project working six days and two nights a week with no vacations or holidays except Christmas and July 4.

"In 1954 I worked with V. J. D'Amato, consulting engineer, who had received an appropriation of $3,000,000 from the governor of Massachusetts for use in a project entailing the fireproofing of various institutions in the state.

"Our next project with the State was on the state highway, designing several bridges. After completion of these projects, D'Amato was appointed Deputy Superintendent of physical facilities at Boston City Hospital and I was asked to work as associate engineer. After three years with the hospital, Mr. D'Amato passed away and I was left without a job. Politics plays an important part in these jobs.

On January 3, 1967 I joined H. W. Lochner, Inc. of Chicago, Ill. in Boston. The work falls within the scope of my earlier experience; I enjoy it and am thankful for Professor Spofford's advice to us." . . . Suren's wife, Artemis, underwent a major operation last fall and is now on the high-road to complete recovery.

Frank Smith's wife, Roberta, passed away December 20 after three days' illness from a heart attack. Frank has moved into 309 Arcadia, 1434 Punahou St., Honolulu, Hawaii, 96822. This is a retirement apartment house run by the Congregational Church and from what he says must be very nice. . . . **Edward Kenway** died December 10. He had lived at 119 Pantry Rd., Sudbury, Mass. 01776.—**Oberlin S. Clark,** Secretary, 50 Leonard Rd., North Weymouth, Mass. 02191

12

DO YOU REMEMBER ANY INTERESTING STORIES OR ANECDOTES of our days at Tech or at subsequent reunions that you can contribute to this column? This paragraph has now started each issue since February, 1968, using material wholly from personal recollections. We are now "out of soap"! Will you make an effort to help?

Jesse Hakes, one of our most dedicated contributors, writes that since "retirement," he is busier than ever. His daily routine includes supervision of a 250-acre farm. He also runs a large wholesale nursery, principally growing rhododendrons and azaleas, and in addition rents five tenant houses and a large part of the land for a dairy. Every house has its own water system, septic system and heating and there is never a dull moment, as something is always breaking down. In addition, he is completely "out of breath" trying to keep ahead of the tax assessor.

He and Mary have for years been expert horticulturists, and are active members of many societies and associations. He writes, "Our best way to get away from home troubles is to attend some of these society meetings. Last spring we went to Callaway Gardens in Georgia for a meeting of the Rhododendron Society. We met many friends and, though my hearing is poor, I still enjoy the cocktail hour. We also attended an enjoyable meeting of the American Horticultural Society in San Francisco where to me, the highlight of the trip was finding the location of my elder brother's grave at the Presidium. He died there in 1901 on his way home from the Philippines and none of the family had ever seen his grave. Last fall we attended another meeting of the American Society in Philadelphia, which gave us an opportunity to try out the new Penn. Central Metroliner, a delightful experience. This year we have already attended the Maryland Society meeting where I always have a display of our nursery products. Later this year we plan to attend meetings in Williamsburg and again in California."

Antonio Romero replied briefly to our inquiry. He spent many years with the Public Service Commission of Puerto Rico, but is no longer in good health. His son, Carlos, is mayor of San Juan. . . . **Harold Mitchell** and Mildred are going strong. Last summer they spent some time in the Arkansas Ozarks, which reminded them of the Blue Ridge Mountains of Virginia. In Fayetteville, they attended the annual meeting of the American Ornithologists Union, which will be held this year near them in Buffalo. Mitch says that he recently lunched with **George Chambers** and talked over old times. George is retired after working many years with the City of Buffalo as an engineer. We hope to hear from him shortly.

Walter Triplett, Course III, writes briefly from Mexico where he has lived for many

years. Until retirement, he was employed as chief geologist of Cia Minera de Pinoles in Monterrey. Walter sent us a copy of a most interesting paper he prepared of a trip he once took by horseback on an unfruitful mineralogical survey of a molybdenum prospect on the Sonora Coast of Mexico, Gulf of California, opposite Tiburon Island. This was followed by a rough voyage on a 56-foot schooner around the island and an overnight stop at an Indian village. They enjoyed a hunting trip and a delicious native fish and lobster dinner before returning to Keno Bay and home. Walter's entire life as a mining engineer, beginning in the days of the Mexican revolution, is replete with exciting adventure and many hardships, both in the dry deserts and beautiful forested mountains, together with many good times at home with family and friends. Physical handicaps now make it difficult for him to travel but he still has tried to spend a few months each year in the States. Walter is celebrating his 83rd birthday this month. Heartiest congratulationsl Walter, from all of us!

Harold Brackett, Course VI, writes from Oradell, N.J., that he is planning an early spring visit with his niece, Elinor Forbes, to Longboat Key, off Sarasota, Fla. We expect to be able to visit with them before we leave for home. . . . **John Pettingell** writes that all is going well. He recently phoned **Clarence Woodward,** Course III, of Melrose, Mass., whom we had been unable to reach by letter. He talked with Mrs. Woodward in Clarence's absence and learned that he is well, active, and drives his auto. He celebrated his 81st birthday last month. Our best wishes, Clarence. Won't you please let us hear from you direct?

Arch Eicher has been improving and we are hoping to hear shortly that he is enjoying a vacation in Florida. . . . A note from **Harold Mabbott,** enclosing some covered bridge clippings, says that he is well but has no news of interest to send for publication. No news is good news, Harold. . . . Also, I received a note from **Harold Manning,** congratulating us on our escape from a most severe northern winter. Come down and join us. There are now thirteen 1912 men in Florida, eight the year round.

On March 6, we attended an enjoyable luncheon meeting of the Southeastern Chapter of the Alumni Club in Sarasota, Florida, with sixteen members present. **John Lenaerts** and your Secretary represented the Class of 1912. We enjoyed a chat with John while at the meeting, as well as with Bill Ball, '05, a former business associate.

Larry Cummings wrote that he was not visiting Florida this year but had planned a trip in March to Guatemala. We hope that he and Julie did not get into any trouble during the revolutionary flare-up, and are waiting to hear from them on their return from what must have been an interesting and exciting trip. As previously reported the Cummings are now living on a farm several miles west of Connersville, Ind. Larry reports much snow and temperatures of 10° below this winter. . . . Add **Howard Cather** and his wife to our list of winter residents in Florida. Word was received that they planned to spend the winter in Naples, as well as in Deerfield Beach. . . . A letter from **Jonathan Noyes** says he is well and active, and looking forward to our next reunion, which has now been postponed until 1972. His wife, Caroline, whom many of us know, is no longer able to travel and due to a recent loss of memory, is living in a nursing home. She is otherwise in good health. John now spends a great deal of time visiting with his six children and 13 grandchildren, most of whom live fairly close to Dallas. Our very best wishes to you, John, and our thanks for your fine comments on the augmented class news, which we are trying hard to maintain.

Paul Tyler and Katherine are still living in their new home at Holmes Beach, Anna Maria Island, Fla., where Helen and I recently enjoyed a nice dinner party. They are both well and are becoming adjusted to the Florida climate and way of living as contrasted with that of Washington, D.C. Paul says he is taking it easy, although Katherine is most active in community, church and hospital affairs.

Jay Pratt and Priscilla returned home from Mexico after a short visit and soon left for Scottsdale, Ariz., "where the sun always shines," according to a card received from the Pratts and the **Cy Springall**s, who live nearby.

We have over 40 requests for news contributions outstanding. To keep our column alive, it is necessary for us to hear from each of you once or twice each year. A long letter is not necessary; just send in a brief note, telling what you and your family have been doing, your general health, and any plans or trips. Have you heard from or seen any classmates recently?—**Ray E. Wilson,** Secretary, 304 Park Ave., Swarthmore, Pa. 19081; **Jay H. Pratt,** Assistant Secretary, 937 Fair Oaks Ave., Oak Park, Ill. 60302

13

R. Charles Thompson, your Class President and **George Philip Capen,** your Class Secretary and Treasurer attended the luncheon of the M.I.T. Boston Club, Thursday, March 12, 1970 at the Dennis Aquarium Restaurant. The guest speaker was Mr. Jerry Blakeley (son of Gerald W. Blakeley, M.I.T. Class of 1912), President of Cabot, Cabot and Forbes, one of the outstanding commercial developers in our country. As usual we met several of our old friends and made some new friends, members of other classes including Arch Morrison and George Rooney of the Class of 1915, David Patten and Donald Webster, Class of 1916.

An interesting note was received from **Gordon Howie,** enclosing a newspaper report of the **George Wallace** family in connection with the dedication of the George R. Wallace Civic Center in Fitchburg, Mass. "Dear Phil, Here is some more very interesting news about classmate George Wallace and Mrs. Wallace. My daughter, Laura, who lives in Worcester, Mass., keeps me informed of many activities in Worcester. Certainly the Wallaces are tops. As you see by the date on the newspaper (January 18, 1970), I am slow in getting this page to you. You probably have already been advised of George's marvelous activities.

"Hope all goes well with you and yours. I am getting to be quite a housekeeper living alone in my apartment, although I have not been elected by any group here as the 'Housekeeper of the Year'. I am fortunate in being near and with many friendly people and groups of people here in Florida. Also my son and wife and his children visit often as they live near. And my other son and wife in New Jersey and daughter in Worcester take time to visit me semi-annually. So, with the aid of the telephone also, I have some happy contacts. My best to you folks."

The Capen family was greatly pleased and honored when a letter was received from our Class President **R. Charles Thompson** and we quote: "March 17, 1970—Dear Phil, Notification is being sent Rosalind Capen that she has been made an honorary member of the Class of 1913, M.I.T., with all the privileges except paying dues. Will you please put her name on the records. Owing to your close association with the candidate, you were not consulted so that no conflict of interests could be made. Very truly yours, R. Charles Thompson."

It is with a very heavy heart that we must announce the death of our very dear friend and classmate, **Joseph C. MacKinnon,** who died Thursday, March 18, 1970 at 100 Memorial Drive, Cambridge. He was buried Saturday, March 21, 1970. His survivors are his dear wife, Helen (Hokanson), his daughter Martha Whitman of Moncton, N.B., Canada, Malcolm Gilson of Franklin, N.H., five grandchildren and ten great-grandchildren. A native of Seattle, Wash., "Mack" graduated with us, receiving a B.S. degree in electrical engineering. He was formerly an instructor in physics at M.I.T. and was appointed registrar in 1923 serving until his retirement in 1956. He also served as assistant secretary of the faculty from 1934 to 1951. During World War II he assisted in the direction of a program of engineering science and management defense training courses at M.I.T. Joe was always a very loyal and cooperative classmate. He was Class Treasurer from graduation until he resigned in 1954 when yours truly took over the treasurership. Present at memorial services were the following representatives of the Class of 1913: R. Charles Thompson, George Philip Capen, Rosalind R. Capen, W. Newsome Eichorn, Charlotte Sage and Warren E. Glaney. To the MacKinnon family, the members of the Class of 1913 offer our most sincere sympathy, and we share your grief.

A notification has been received from the Alumni Association office of the death on February 25, 1970 of **E. Bruce Cotton** of 64 Sewall Ave., Brookline, Mass. 01246. He graduated and received his B.S. degree in mechanical engineering. He will be greatly missed by his family and former classmates.

A very pleasing letter was received from Margaret Rogers which reads as follows: "Dear Phil, Thank you so much for your note of sympathy. Sam and I had many happy years together, for which I am very grateful and that does help. I have had quite a few messages from former classmates and fraternity brothers of Sam. These mean a great deal to me. Sincerely, Margaret Rogers."

Following several telephone conversations lately, we have learned that several of our classmates are enjoying retirement, and some are facing the usual old age ailments, so we pass on to you our observations: Ellen and **Ellis Brewster** left last Sunday for a month's sojourn to Florida; **John Farwell** has been hospitalized for a check-up; the **Philip Terry**s have just returned from a vacation in Florida; **Howard Currier** has remarried; **Francis Achard** is again enjoying good health, but his wife Florence is recovering from minor surgery; **William Newsome Eichorn** is well, but his wife Dorothy is trying to recover from a visit to the hospital; **Edward Hurst** has recently returned home after a successful check-up. He is spending considerable effort and time inventing visual and audio aids for the blind and disabled.

Burton Cushing is still teaching mathematics at Fisher Junior College; **George Dempsey** is recovering from surgery, but will soon be able to travel again; **Joseph Cohen** states he is in good health and adds, "Say hello to all the boys"; **Charles Wood** sold his business two years ago, but he is enjoying the several "old man" difficulties to which most of us are subject; **Stuart Eynon** is still active, but is now recovering from "flu"; **John Hession** is still conducting his engineering practice, but his wife is ailing; **Joseph Isenberg** is still in business, but due to his many family activities, he states that he has not been able to visit M.I.T. as much as he desires, so says "Hello, Friends." **David Stern** reports that he and his nice wife Della have just returned from a two weeks' trip to California. . . . To all of you who are still active in your vocations, keep up the good work. To you or your family who have ailments, realize your good fortune, for there are many more unfortunate. . . . Signing off until the June issue.—**George Philip Capen,** Secretary & Treasurer, 60 Everett St., Canton, Mass. 02021

14

Frank Atwood sends a chatty note from that area of past scandal: "Dear Herman, I recall your phone call last fall when you were getting ready to have an operation on your eyes. I hope it came out all right and since I am still reading class notes in the *Review* I assume you are all right. While in Boston in December I had a nice phone talk with Florence and Harold (Richmond). They also were concerned to know how you were.

"As you know, we had a very hectic January here because of the Kennedy inquest. We were loaded up with reporters and TV men from all over the country and many from abroad. Of course they got very little information but some of them made up stories. After that we had a movie group here for a while. Since then it has been reasonably normal. January was quite cold but February has been very comfortable and no snow and very little rain. If you were a golfer you would enjoy a trip here. Otherwise I think you would really enjoy a trip down here for other reasons. Hope you can come down sometime and be our personal guests. Regards, Frank Atwood." I am sure his invitation would be extended to all our classmates. It is a very attractive location.

Hugh Chatfield has passed along a few bits of news from his letter file. Included is an excerpt from correspondence with **Bob Townsend** saying: "We are planning a month's trip south, visiting Atlanta and Baton Rouge where our two daughters and their families live. Also in May we are planning a flight to Colorado to attend the graduation of our eldest grandson from the University of Colorado in Boulder. He has taken a combination of sciences there. Also there is the possibility of a short trip to New England in the fall." Dinny also mentions that, with his family, they are spending March 13 to 30 on their 17th trip to the St. Petersburg, Fla., area.—**Herman A. Affel,** Secretary, Rome, Maine. Mail: RFD 2, Oakland, Maine 04963

15

Here it is the merry month of May with only a short time before our 55th reunion at Coonamessett Inn, Falmouth, Mass. on June 12-14. This will be followed, upon our return to Boston on Sunday, by Alumni Day at M.I.T. on Monday, June 15 and our big annual class cocktail party (FREE) at 4 p.m., Monday at the M.I.T. Faculty Club. Then our class dinner in an adjoining dining room at the Club (no long walking). Then, cordials at Bill Smith's 19th deck apartment at 10 Emerson Place, Boston. Barbara Thomas will be on hand to welcome you to the class cocktail party, and Bill Smith's charming sisters Charlotte and Florence and his lovely guest, Ruth, will greet you at his apartment for cordials. Since there will be no Alumni Dinner over at M.I.T. on Monday, Alumni Day, why not all join together at the class dinner at the M.I.T. Faculty Club. Transportation, under Wally Pike's direction, will be furnished from the Faculty Club to Bill Smith's in Boston. You've all had your reunion notices. Send that reservation in *at once.* We must have it by May 20 to guarantee our reservations. This may be our last reunion, so let's make it a successful one.

1915

55th Reunion
June 12-14
Coonamessett Inn
Falmouth, Massachusetts

Annual Class Cocktail Party and Dinner
June 15 at 4:00 p.m.
M.I.T. Faculty Club

Azel W. Mack, Chairman
100 Memorial Drive
Cambridge, Mass. 02139

Ben Neal is carrying on with the annual Alumni Fund program and doing his usual energetic and successful job. . . . In a letter from U.S.O. Headquarters in New York **Mary Plummer Rice** wrote her Mayflower cousin, **Al Sampson:** "This is a quiet day at the U.S.O. Club here. It really peps up in the evening. If I could only write, I could do a book about humanity —Times Square humanity, that is! I'm a receptionist and what tries to get into this Club for G.I.'s is amazing. It takes everything I've ever learned studying psychology and psychiatry for thirty years and some times I have no answer at all. I'll be in Washington for the D.A.R. meeting and in Cambridge in June for Radcliffe and 1915 Reunions. I leave June 28 for the opening of the Frankfurt, Germany U.S.O. At last, the Bonn Government has seen reason and is permitting our first U.S.O. Club to open there. Our G.I.'s in Germany so often get into trouble and have no place to go. Later, I'll be at the Paris U.S.O. for two weeks, then London, then back on the continent until October." Hats off to Mary. How does she do it? We'll all be glad to see her at our 55th in June. Mary sent a service magazine clip with a very good picture of herself at a "U.S.O. Saigon" table somewhere out there in Vietnam. The caption read "At the Saigon U.S.O. Club, Mrs. Julian Rice of Bronxville, New York, is having coffee with some of the military. Mrs. Rice has been a U.S.O. volunteer in the states for many years. She had been visiting Hong Kong and decided to take a quick trip to Vietnam to see U.S.O. in action for herself. Mrs. Rice is Co-Chairman National Society U.SO. Committee N.S.N.E.W." Wonderful for Mary!

On a yellowing letterhead of the Technology Club of New York, 24 East 39th Street, Mary sent us the note we sent her from there on the night of May 23, 1941. We had a class dinner there, and Mary came all the way downtown to be with us, only to find no ladies were allowed in the Club. It was a sad rebuff, and we were all very sorry and indicated it with the remarks we added to our signatures.

Present was Dr. James C. Duff, 1896. Do any of you remember him and why he was with us?

In addition to Dr. Duff, present were—Everett Brigham, Fred Cook, Jerry Coldwell, Alan Dana, Chauncy Durkee, Ralph Hart, Wink Howlett, Joe Livermore, Azel Mack, Hank Marion, Tower Piza, Pirate Rooney, Frank Scully, Henry Sheils, Cliff Sifton, Ed Stearns, Bur Swain, Kebe Tobe, Ray Walcott, Max Woythaler, Charlie Williams and Louie Zepfler. A fine crowd! It's sad to recall that nine of those 23 present have passed away. Jerry Coldwell, Ralph Hart, Joe Livermore, Bur Swain, Ray Walcott and Charlie Williams are still living in metropolitan New York and attend regularly our annual New York City dinner at the Chemists' Club there. A fine crowd—a fine Class—Supreme! There will probably be a June and July issue of the *Review,* and for our column you really must "help Azel."—**Azel W. Mack,** Secretary, 100 Memorial Dr., Cambridge, Mass. 02139

16

A Swiss-stamped winter-ski-scene postcard received in early January bore the notation: "Davos, Berghotel Jakobshorn und Skilift" and the message: "It's a great life if . . . most of the time anyway. See you in June." One guess, and you're right—it was from Sibyl and **Ralph Fletcher** on one of their for-many-years ski outings in Davos!

And now our ever-going president says: "Just a month to go and we'll all again be reunioning at Chatham Bars Inn, Chatham, Cape Cod, for our 54th reunion. The dates are Friday, Saturday and Sunday, June 12, 13, 14. We look forward again to an excellent attendance and the planning for our 55th next year. As indicated in an earlier column, we plan to address ourselves at our business meeting to some of the controversies which presently are diminishing the Institute. We sincerely hope that you will attend. If you can't be present and want to contribute to the discussion, send us your thoughts to be received no later than June 12, c/o Chatham Bars Inn, Chatham, Mass. This should be another great weekend."

Another Honor

Congratulations again to **Van Bush!** Back in February President Nixon awarded gold medals and citations as atomic pioneers to our Van, James B. Conant and Lieutenant General Leslie Groves, '17. As reported in the February 28 issue of the *Boston Herald:* "The trio was in on the ground floor in developing the atomic bomb, and the special awards made to them will not be repeated for others. 'This really quantum breakthrough in the knowledge,' Nixon said, 'had a very dramatic impact on the thinking of the scientific world, the thinking that moved from atomic energy to space.' Dr. Glenn T. Seaborg, chairman of the Atomic Energy Commission, proposed the unique, one-time awards and was on hand for the ceremony. Bush, 79, a longtime professor at Massachusetts Institute of Technology, headed the Office of Scientific Research and Development in World War II."

Earlier in February we had word from Van, that although in a month he would be 80, he was still busy on a few things that he was personally interested in. "One of them is an attempt to reduce the pollution from automobiles, on which a very large number of men are without doubt working today."

Our Travelers

We have a good letter from **Elizabeth Pattee,** our retired Professor of Landscape Gardening (R.I. School of Design), of the beautiful retirement community of Meadow Lakes, Hightstown, N.J., where Barbara and **Arthur Caldwell** also, but more recently, have taken residence. Elizabeth tells of her last summer travels with a friend, by way of Iceland to Luxemburg and subsequent driving through Germany, Austria, the Italian Lake district, Switzerland and back to Luxemburg. "We found Iceland," she says, "quite worth while, with its geysers and hot water springs that are the source of all heating and hot water for the Iceland communities. The waterfalls and the volcanic island that erupted from the sea in 1963 and which is still active and growing in size, were spectacular. . . . At various times I have gone over to meetings of the International Federation of Landscape Architects which have taken place in European cities and it was pleasant to visit some of the cities and some of the people I had met on those occasions. There is always plenty of interesting architecture to see along the way, and on this trip a lot of grand mountain scenery. The driving and roads were excellent in all countries and motoring very easy and pleasant, except for traffic in the larger cities like Munich and Vienna which was terrific, with parking almost impossible—much worse than anything I have ever seen over there before. It was the same in England where I later visited friends in different parts of the country. . . . I am setting the 1971 reunion down on my calendar as a definite time to be reserved, barring the vicissitudes that can happen to any of us at our age."

From **Walt Binger** comes an interesting account of his and Beatrice's week's stay at and near Nassau, B.W.I., where the board of the National Audubon Society met late in January. As chairman of the executive committee, Walt called a breakfast meeting which then merged with the board which sat through lunch until late afternoon. Twenty-five of the thirty-five members attended, some from as far away as Texas and California. Then, says Walt: "We then picked up our spouses and attended a reception and cocktail party by the Governor General followed by dinner given by local conservation groups. Next day a chartered plane carrying the whole group flew to the island of Inagua, largely owned by the Morton Salt Company. Here the largest breeding ground for flamingos in the whole region was ceded by Morton for 99 years to the Bahama National Trust. They in turn gave over to Audubon the management of the area. While Beatrice and I are not inclined to take winter vacations away from New York, we thought it would be foolish to go back too soon so we flew sixty miles to the Pink Sands Hotel on Harbour Island. Here there is no main residence building, everyone living in small cottages overlooking a magnificent beach. . . . Not wishing to give any false impression I should admit that one could write an authoritative book on birds by using only those things I don't know. However, I have for many years been interested in conservation (National Audubon Society's principal interest) and particularly in trying to influence those engineering societies of which I am a member to take a much broader view than considering only the cost of a given public project and that that alone may be a very short-term attitude. As the then-president of Audubon told me five years ago: 'The people of the U.S. are ready to stand up and be counted.' Since then National Audubon's membership has grown from 34,000 to 88,000!"

Another traveler, perhaps a super-traveler, is our **Rudi Gruber.** He returned in January from a month's vacation in Europe, celebrating Christmas with his brother Friedrich in Odenwald, near Frankfurt, and New Year's with his sister Eva in Hamburg—a late session with "punch" and "Rheinwein!" Says Rudi, "Most interesting were talks with the younger generation in Germany. Some of them had been in the U.S.A. recently on short visits. It was fascinating to hear their opinions of the U.S.A.—mostly full of admiration. Germany seems to be 'over the hump' as far as student rebellions are concerned. They are working hard—and successfully so. All of the visitors had seen M.I.T. under my guidance and were most impressed. My philosophy: I am optimistic, in the long run, about 'pax in terra'—eventually." Then on February 1, Rudi attended the performance of "Flying Dutchman" at the Kresge Auditorium at Tech, invited by Vincent Fulmer, Vice President and Secretary of M.I.T., with Dean Hammerness, Foreign Student Aid, as his host.

Baseball

Still actively quoted in sports-management circles is our **George Petit,** quoted because of his output of inferences and predictions in reference to baseball statistics, won-and-lost columns and pennants. As George puts it, he is in his 78th year of contentment in thinking, writing and computing, and finds this "far more alluring than thoughts of retreating to balmy shores or travel in foreign lands." His latest writings and analyses appeared in the January 7 issue of the *Hartford Courant,* in the "Malice Toward None" column by Bill Lee, Sports Editor. There, Lee quotes a half column of some 11 observations by George regarding the "reserve clause" and major league baseball. All this will be available at the reunion and not only that, we'll have on hand a copy of the "Dear George" letter from

his "boss", Ed Short, Vice President, Director of Player Personnel of the Chicago White Sox, which says: "I hope the ball players and the representatives have as far-sighted a view in the Reserve Clause matter as you expressed in this article." Nice going, George!

In Memory

We regret we must report the death of **Ray** (Raymond G.) **Brown** suddenly at home in Niagara Falls, N.Y., on December 8. Ray went to Niagara Falls in 1917 as an assistant to Dr. Ernest Westcott, became vice president of Comstock-Westcott, Inc., a research firm there, and later was vice president and manager of Strategic-Udy Processes, Inc., also of Niagara Falls. The parent company of the local branch of Comstock-Westcott was located in Cambridge. As indicated in the December 8 issue of the *Niagara Falls Gazette:* "Mr. Brown was a member of the American Chemical Society, the American Institute of Chemists, the Niagara Falls Country Club and the Niagara Club. He was also a member of the board of Comstock-Westcott, Mass., and president of the board of the Niagara Falls Memorial Society. During World War II he served in the Chemical Warfare Service at Charlestown, W. Va. He returned to this city after the war and took up employment with Comstock and Westcott as assistant to the vice president. He later became manager, retiring in 1963. Since that time he had served as a research consultant. He is survived by his widow, Melva; three sons, Roger Brown of Cleveland, Peter N. Brown of Boston and Richard L. Brown of Elmira; and eight grandchildren."

We also regret to report that **Gordon Fair** died in Mt. Auburn Hospital in Cambridge on February 11. In the January issue, we outlined his illustrious career in the field of sanitary engineering, as we reported on the Lewis L. Dollinger Pure Environment Award to him by the Franklin Institute last October. From the February 13 issue of the *Boston Herald Traveler* we have a number of additional items about him—items outside his work as a teacher at Harvard from 1918 to 1965, as Dean of the Graduate School from 1946 to 1949, as a researcher, as Gordon McKay Professor of Sanitary Engineering, and as Master of Dunster House from 1948 to 1962. He worked with international health organizations to bring sanitary technology to underdeveloped countries. "He also worked with the Institute of Inter-American Affairs to promote health through engineering in Latin America and advised the U.S. Foreign Operations Administration on its policies in this field. In his retirement years, Professor Fair was active on commissions studying Great Lakes and New England water pollution problems, as well as heading a federally funded research project on the separation of combined sewerage systems. He leaves his wife, the former Esther Lansing Mead, and two sons, Gordon M., Jr., of Lexington and C. Lansing of Cambridge."

And our **Herb Gfroerer,** co-founder and retired board chairman of SoundScriber Corp., died on February 25 after a long illness. As reported in the February 26 issue of the *New Haven Register,* "Prior to organizing SoundScriber Corp. in 1940, Mr. Gfroerer was associated with Chrysler Corp. and with General Motors. He retired as chief executive of the electronic dictating equipment firm in 1950. He was a lieutenant in World War I, and was a close friend of Sir Winston Churchill. In 1966, Mr. Gfroerer donated his extensive collection of Churchill memorabilia to the Yale Sound Recording Library. He was a member of the Graduates' Club of New Haven and the High Lane Club. Several years ago he had been a senior trustee of the Spring Glen Congregational Church, a president of the Spring Glen School P.T.A., and had served on the Hopkins Grammar School Council." He leaves his wife, Fannie Palmer Gfroerer; a son, Wesley Gfroerer of New York City; and two brothers, Frank Gfroerer of Boston and Rudolph Gfroerer of Fort Lauderdale, Fla.

From the Mail Bag

For our do-you-remember column, **Willard Brown** of Santa Barbara recalls the serious-mindedness of the Course VI (E.E.) Vectors Club, of which **Jap Carr** or **Joe Barker** was president. On one occasion they planned a dinner at a small but sportive kind of restaurant with a reputation. Says Willard: "Well, somehow they got the idea and I confess I didn't say anything to controvert it, that we were a group that liked its liquor, and would probably order a considerable quantity of drinks. So, they gave us a price on the 'dinner' which made it a very good buy, especially in that place. Well, the dinner lived up to expectations but we bought practically no drinks, and I can well remember the frigid politeness when we paid the dinner bill! Obviously, we never considered going back there again. But it was a good evening as I recall." Further, but hard to believe, Willard says that he and **Cary Easley,** both relieved from the "incredibly rigid and difficult routine of V.M.I." whence they came, considered their life at M.I.T. "something in the nature of a continuous picnic which was just not understood at all by our hard-laboring fraternity brothers!" Hm! . . . **Jack Camp** of Mexico City has a gem of an essay on the definitions of such terms as "students" and "human," with comments relating to chimps and crows. We may have to tell more if our readership insists.

We are pleased to have at hand the latest issue (February 1970) of "The Southwest News," edited and published by Virginia and **Joel Connolly,** respectively. Four pages of really interesting material—you really should have a copy; write for yours to them at Box 17132, Tucson, Ariz. 85710. Here is an item that we marked with a red pencil in their "News": "Marriage Counselling: Marriage causes more divorces than strong drink. When asked why she never married, an old lady said she would rather go through life wishing for something she did not have, than wishing she could get rid of something she had. Consult us before you wed! N. Glanders, Inc. Adv."

Now, on to the South, and we have word from **Everett Johnson** of Monroe, La. He is quick to sympathize with the **Vertrees Youngs'** problems that resulted from the staggering ravages of Hurricane Camille last August. Says Everett: "Before my retirement I had charge of the insect control following most of the hurricanes, tornadoes and such disasters. I couldn't visualize that Camille left very much and I know just what Vert is going through." . . . **Coke Flannagan** of Inverness states that he has just one item to report—the arrival of a new granddaughter. Says Coke: "John and his wife had a son about 12 years ago—no children since—so the new arrival came as a surprise to us." Alma and Coke have been more than active lately, moving from their lake place to a house they have bought in town, one requiring "extensive renovation and some remodeling. Between the roofers, tilers, plumbers, painters and carpenters we have been in a dither ever since and are still stepping over packing boxes and trying to find and store what we need."

We are glad to mention **Jap Carr's** February report that he is getting along well on his recovery path after his June coronary. He notes: "Walking a mile and a half a day and just started fifteen or twenty minutes of easy tennis twice a week last week. I prefer swimming to walking but the weather has been too cold." . . . Out in Hammond, Ind., **Ed Hanford** tells of hanging an old portrait of his great-grandfather in the living room. "It is painted on a wooden panel, artist unknown. Capt. Wm. Hanford: he was born in S. Norwalk, Conn. in 1795, and lived most of his life in St. Augustine, Fla., where he died in 1862. The story is that he was captain of the first steamer between New York City and St. Augustine."

And finally a note of appreciation to the many of you who send notes and clippings and '16 bits of interest, both general and particular. We have additional items to report from Howard Claussen, Spotts McDowell, Elbridge Devine and Saul Hoffman. Just keep the news and bits of philosophy coming in, come to the reunion on June 12, 13 and 14, and write a little but write often to your still-willing-to-work secretaries—**Harold F. Dodge,** Secretary, 96 Briarcliff Rd., Mountain Lakes, N.J. 07046; **Leonard Stone,** Assistant Secretary 34-16 85th St., Jackson Heights, N.Y. 11372

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Following up on the reunion action of last fall of electing former President Julius Stratton to be an honorary member of 1917, a red blazer was given to him. He has responded, "I returned home from a trip abroad to learn with much sadness of Dix Proctor's death. The Class and I have lost a fine friend. While I was away, the 1917 blazer which Dix had ordered for me arrived and to my delight it fits me better than

any other coat I have. With all my thanks again to you and to the Class. Sincerely, Jay."

Three men who played a major role in World War II development of nuclear weapons and subsequent support of scientific research, received from President Nixon, on February 27, a unique "Atomic Pioneer Award." It is a special award which will not be bestowed on any other recipients in the future. The men were Dr. Vannevar Bush, Dr. James B. Conant and Lieutenant General **Leslie R. Groves.** The citation to Les reads: "For his exceptional contributions to the national security as Commanding General of the Manhattan Engineer District, United States Army, in developing the world's first nuclear weapons during World War II, and for his pioneering efforts in establishing administrative patterns adopted by the Atomic Energy Commission in effecting the use of atomic energy for military and peaceful purposes." Les, a Corps of Engineers officer, demanded and received the highest wartime materials priority for the Manhattan Project and provided much of the drive and sense of urgency that made the project successful.

Those Dennens do get around, for a card from **Al Lunn** from Mexico City says that the Fiesta is a fine party, the weather good and that 1917 is represented by Conchita, Anne (Mrs. Dean) Parker, the Dennens, for whom it is the 14th Fiesta and Al himself, for whom the Fiesta is number 8.

The April notes recorded the death of **Francisco Sada, Jr.** After graduation he returned to Monterrey, Mexico and entered the cattle and agricultural business. He became active in numerous civic and business organizations, founding the Nuevo Leon Cattle Association, being its president several times. He also founded the local bank and was a director of the Mexican Commercial Bank of Monterrey. He always lived a very active and full life and his passing on August 15, 1969 was deeply regretted. He is survived by his wife, seven children and grandchildren.

Here is what **Cliff Lansil** writes in reply to a note from Brick Dunham. Cliff taught at the Institute for years, then got into the industrial field. "I wish there was some way that students could be made to realize that the subject matter they study will probably be used rarely, if ever. Yet it would be difficult to find any position in which they would not have to use all of the processes of thinking, observing and analyzing which were required to complete their course. Much of the material they learned is obsolete by the time they are ready to use it. The mental processes, however, are not greatly different today than they were 5,000 years ago. Of course, with increased information at our disposal, the results may be more accurate, in some fields at least, but keeping up to date on that information is a life-long job. In my own case, I probably used the original subject matter, particularly mathematics, more than most others have done. Yet most of that use was what I learned from such masters as Professor Wilson, Professor Lipka and 'Dinty' Moore, rather than the texts. They taught me how to avoid mathematics and come up with usable answers that 'couldn't be found'. That is by rigorous mathematics at least. Many a student thinks that when he receives a degree in engineering, he has automatically become an engineer. Little does he realize that all he has is a set of tools, and that he still has to learn how to use them—by experience. And so 'us oldsters' ramble on while, fortunately, most 'youngsters' come to recognize the fallacy of their assumption of 'immediate wisdom' and develop into engineers worthy to take over the great profession of engineering."

Have you made your Alumni Fund contribution? Unless otherwise designated all gifts go toward the Buzz Aldrin Scholarship Fund and we want to put that over. . . . Boston Pops with Arthur Fiedler, Sunday evening, June 14! Be sure to make your reservations early for this event and for Alumni Day, June 15.—**Stanley C. Dunning,** Secretary, 6 Jason St., Arlington, Mass. 02174

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Here are some excerpts from a letter written in February by our keeper of the funds, **Fred Philbrick** from Coral Cables, Fla. We had planned on an interim reunion possibly in Florida in the spring, but it appears any plans in this direction will be postponed until next year. "Dear Max: I delayed replying to your letter of February 2, until I could talk to Harry Levine. He lives in Miami Beach, and is the only one of our classmates with whom I have close contact. I see Granville Smith in Sarasota occasionally. Stuart Boyd of Pompano Beach, and Al Sawyer of Ormond Beach attended our last reunion, but the other members of our class listed as living in Florida, I have not seen since graduation. You have evidently given up the idea of a reunion in Florida this year. Of course, I would like to have a reunion here some time, but obviously, you must choose a place which is available to the greatest number.

"We have all been very much disturbed by two recent developments at the Institute. One is its apparent failure to act firmly against the thugs who broke into the President's office. So far, we have not been advised as to the results of any action taken against them. I wrote President Johnson as soon as I learned of it, urging that all students and *faculty* involved in such action should be immediately and permanently separated from the Institute. We have received several bulletins from the President and Alumni Association advising of these violations of the law; but up to date, no definite reports as to the results of any action taken by the Institute to restore law and order. If you know of any such action, I would like to know and I am sure that Harry Levine would also.

"As to my personal affairs, I am enjoying reasonably good health, with my pacemaker, and find plenty to keep me busy, trying among other things, to make my income keep up with inflation. In our backyard I grow oranges, papayas, mangoes, lychees, limes, and have two Hawaiian pineapples well started. I am satisfied that life is easier for me here than in New England, and could strongly recommend it for anyone over 39. We are always glad to hear from you, and of course, if you should ever get in our neighborhood, you will be extremely welcome, with your good wife."

Here is an excerpt from **Harold Collins'** letter to **Len Levine:** "Dear Len:
You would never believe from the time that it has taken me to reply how much I enjoyed hearing from you. 'Remember me? M.I.T. 1918-2', well you just bet I do and you are about right when you say that the last time we met was at a reunion 15 years ago in 1953, our 35th and actually 17 years ago. My wife Betty and I have often spoken of you and your charming wife when visiting with my mother in West Newton. If my memory is not faulty you lived in Waban at that time.

"I was formally retired in 1962 as vice president-sales at Metals Disintegrating Co., then a division of Martin-Marietta Co. However, I was retained on a contractual basis to complete market development of a spherical aluminum powder which our company had developed as one of the components of solid fuel employed in rocket engines by the Space Agency. To a certain extent I enjoyed retirement, but the lack of some definite task to be performed each day really spoiled the freedom one felt with retirement. So in January 1968, I became associated with the Better Business Bureau of Metropolitan New York and really enjoyed my short-lived association, as on June 1, 1968, I was laid low with a heart attack and spent the month of June in the hospital. Although I seem to have effected a complete recovery, I guess my working days are over. I was particularly unhappy about being hospitalized at that time as my brother, Bill, also a 1918er, had planned to attend the 50th reunion and renew old acquaintances. Although I do have my red coat, I did not have the privilege of the reunion. Both you and Max are to be complimented for your interest in our Class and I feel that Max has done an outstanding job as class secretary. I feel extremely guilty in not showing my appreciation in a more concrete manner. But actually, Len, I am not one of those who can point with pride to the accomplishments of their business careers. I always have enjoyed my business associations and associates and although the results of my efforts were mostly gratifying to me, they do not in my opinion constitute major earth-shattering accomplishments.

"I did have the privilege of twice serving in the military service, leaving the service in World War I as a second lieutenant and World War II as a lieutenant colonel. As a result of my efforts in the latter conflict I was appointed an Honorary Officer of the Military Division of the Most Excellent Order of the British Empire. Of this, naturally, I am quite proud. May I repeat my comments at the start of this letter in saying how much I enjoyed hearing from you and also how much I admire the most excellent work which both Max and you are doing for the Class of 1918. Betty joins with me in conveying to your nice wife and to yourself our kindest regards and best wishes. Sincerely, Harold."

Our youngest-appearing classmate (on the authority of my wife—he has all his hair) took time out on board the S.S. *Santa Mariana,* en route from Valparaiso to Calleo, to send us his most welcome story about events from Copley Square to Phoenix, Md. At our next reunion, Frances and **Pete Harrall** will have to fill us in on some of their travels."Dear Max: At long last, I am beginning the task of writing you at length in accordance with your many requests and reminders over the past year. We are at the mid-point of a South American cruise and there is occasionally some time for reading, writing and currency arithmetics (what with Panama, Equador, Peru and Chile).

"From 1963 to 1966, my work was as Business Manager of the Bryn Mawr School, an exclusive and fashionable girls' school—daytime only, with 520 pupils and a faculty of 73 (female). With two . . . porters and a . . . gardener, I was the only other man on the property. . . . I retired from this job in 1966, to start a program of travel which we had been planning for several years.

"Our travel program, referred to above has developed as we have gone along, and may be separated into parts as follows: a trip around the U.S. by car, visiting about 40 states including Hawaii and Canada; 29,000 miles by air through Asia as far as Signapore, with plenty of intermediate stops going and coming; 8 months and 17,000 miles in Europe by car in the fall and winter of 1967-68; and a trip to Florida in 1969, by train. In between the principal journeys, we had trips by air to North Carolina, Texas, New England, the Mid-West, North and South Carolina. So far we have travelled nearly 87,000 miles, this present journey being about 5,300 miles one way. We enjoy travel and are trying to do all we can while we are well and able. There is a lot of the world we would like to see, but haven't as yet.

"For hobbies, I'm a 'do-it-your selfer' in many things. We play a little golf and after 55 years at it, I am not much better than I was when I began. Play around in about 100 and have lots of fun in the process. Since I'm now completely retired, I read a lot. Not as yet addicted to radio or television except for news and now and then a special program. I have a large lawn and 15 acres of pasture to keep mowed, and numerous small chores around the place which use some of my spare time. Over the years, I have been active in my church (Episcopal) and in hospital and community work, some political activity when I lived in New Jersey and presently Chamber of Commerce work in Tonsom, where I'm a director of the local chamber. My wife is very active and successful in real estate and we live a busy, active and happy life. We have two children, both married, and five grandchildren, the oldest 18 and the youngest 6 months. We consider ourselves to be lucky people with much good health and so many blessings to be thankful for. Incidentally, when I finally retired for good in 1969, I had worked at one job or another exactly 50 years, less 11 days. Being completely retired is a real joy to me, and I hope not too hard on my family and associates.

"In the field of unusual activities for a civil engineering graduate of M.I.T. . . . my wife and I operated and owned a live animal farm with 400 hogs, 100 sheep, 50 beef cattle, 500 chickens, and numerous other livestock. She supervised the operation and I did the repair work and the veterinary medicine chores. We sent to market 6,000 pounds of pork on the hoof and 50 to 75 lambs each year. Because of Frances' activities in sales and sales management, and her other interests, she is listed in *Who's Who of American Women, Who's Who in the East, World Who's Who of Commerce and Industry, International Biography* and *Personalities of the South.*

"I guess the above about covers the waterfront. The story is too long as it is, but some items must be left out. For Frances and me, these are the golden years, with lots of problems and failures as well as successes behind us. We are certainly trying to 'make do' most of this present while we have it. Best regards to you and Selma, Max, and thank you for urging me to write this."

I am happy to report that my appeal for news from all of you filters in now and then—and makes my job as secretary rewarding. Here is **Sherwood Taber**'s story: "Dear Max: Your recent request together with the other evidence of your devotion to the job of Class Secretary have caused me to submit the following. Because of commuting from Canton during my years at the Institute, I was not active socially and made few close friends. I left in 1917 to accept a commission as second lieutenant in the Coast Artillery Corps. Was about to go overseas when the armistice was signed and my orders changed, sending me to the Canal Zone for two years. After returning to the States I married Hazel York, a graduate of Massachusetts Normal Art School, class of 1917, and a long-time friend and neighbor. We went to California in 1922 and I went to work for the Southern California Telephone Co. in the maintenance department. Thirty-six years later in 1959 I retired. Nothing noteworthy about my career except occasional fires, floods, and earthquakes which served to break the monotony. Six children were born of our marriage. My first born, a daughter, passed away in 1962; the others now occupy useful positions in society or business. They have provided me with 18 grandchildren to amuse and entertain me. The oldest of them are now or soon will be graduating from high school and commencing their careers.

"I have lived at the same address for nearly thirty-five years and expect to end my days here. Since losing my wife in 1967 I have lived alone, except for occasional visits from my children or grandchildren, and while I do not particularly like this form of living, I am reconciled to it. My health is as good as could be expected at 75 and aside from a few assorted aches and pains and creaking of the joints I have no known disability. My recollections of the Institute are all pleasant and a few of the professors made a lasting impression. Dr. Talbot, Dr. Fay, Dr. Lewis, Dr. Lipka and Major Cole come to mind but are by no means the only ones. I think the dissidents of the present generation should be given a choice: Make good use of the facilities and opportunity provided for you by the efforts of your predecessors, or take the first boat to one of the communistic countries and endeavor to convert them. I do not mean by this that I am averse to adopting suggestions for improvement or change offered in the proper way, but I do firmly believe that violence and disruption should be met with whatever strength or courage is necessary to preserve our institutions for the great majority who appreciate and profit from their opportunities."

I am much impressed with your comments coming in the mail about M.I.T. and its problems. I am happy to include as much of it as I can in these columns with a minimum of editing. In the confrontations between student and university in the last decade the participation of the alumni has been negligible. A most serious problem facing the privately supported educational institution is the financial one. Costs are rising faster than income. M.I.T.'s support from us, industry, foundations and so on depends on the impact that we, the product of our alma mater, make on society. So become more involved with our Tech that used to be on Boylston Street; write me your thoughts on M.I.T.—what it is doing or ought to be doing—and I will include them in these columns.—**Max Seltzer,** Secretary, 60 Longwood Ave., Brookline, Mass.

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Word has been received that Miss **Marion Daniels** who was living in Saint Monica's

Home, 125 Highland St., Roxbury, Mass. 02119, passed away on January 9, 1970.

Edward F. Deacon now resides in Apt. 112, Biltmore Garden Apts., 700 Biltmore Ave., Asheville, N.C. 28803.

Your secretary has had word from **"Ren" Smith, Nelson Bond** and **John Stevens** during the past month. They are all well and active.

It is hoped that many classmates will find it possible to meet at Chatham Bars Inn on June 12-14 preceding Alumni Day at M.I.T. on June 15.

On February 25 your secretary moved to 50 East Road, Apt. 11E, Barr Terrace Apts. in Delray Beach, Florida 33444 (Telephone 305-278-4537) after selling his 30 School Lane, Scarsdale, N.Y. residence in January. . . . More notes from the Class would be appreciated.—**Eugene R. Smoley,** Secretary, Apt. 11E, Barr Terrace Apts., Delray Beach, Fla. 33444

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By this time the class exodus from Florida is well advanced. We count on inspecting the rich tans acquired by our numerous denizens of the southland when they check in at the great reunion. Hasta la vista!

Mina and **Perk Bugbee** drove to Florida in March and report a very pleasant visit with Beth and **Ed Ryer** in Naples. While there he ran into **Dick Soderberg** and **Irwin Moore** as well as Ray Stevens, '17.

Further information about our distinguished classmate, **Ernie Huntress,** is contained in a letter to the faculty containing the news of Ernie's passing on February 1. President Johnson writes, "Professor Huntress was especially noted for his research work on the identification of organic compounds and he developed the use of chemicals which fluoresce in ultraviolet light. He published over one hundred technical papers, held a number of patents and was author of five books."

When last heard from, **Arthur Roberts,** formerly chief engineer of Colonnade Co., Cleveland, was in Chagrin Falls, address 212 North Main St. . . . **John Elliott**'s latest address is 57 Philips Dr., Newburyport, Mass.

At this writing, your Secretary is about to take off with Mary and **Buck Clark** on a junket to Utica, N.Y. where the International Curling Bonspiel is to be held. Buck had such a good time at this affair in Scotland last year that he persuaded us to take it in even though we are confirmed candlepin bowlers and therefore cannot trifle with our good right arms by careening those heavy stones down a sheet of ice. We look forward to seeing those ardent curlers, Pat and **Buzz Burroughs** at this gala curling event.

This morning's newspaper contains sad news of the death of Anna Shlager, wife of our own **Abe Shlager** of 15 Thatcher St., Brookline. Mrs. Shlager was president of the women's division of the American Technician Society. The Class extends deepest sympathy to Abe and his son, Julian.—**Harold Bugbee,** Secretary, 21 Everell Rd., Winchester, Mass. 01890

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This may be the last opportunity to remind you of participation by the Class of '21 in Homecoming '70 in Cambridge next June 14 and 15. Members of the Class and their wives will have an informal dinner in the main dining room of the Charter House, Cambridge Parkway, about a mile down Memorial Drive from M.I.T. We will meet between 5:30 and 6 p.m. on Sunday, June 14. No reservations are needed. We will use the available hotel facilities as required. After dinner some may wish to go to Boston for the Pops with Arthur Fiedler, for which the Alumni Association has booked Symphony Hall. Late comers and others can, of course, remain for further socializing with the dinner group. You should make reservations for the programmed events on campus on June 15. As usual, we will meet for luncheon in the Great Court and will have assigned tables for dinner in Rockwell Cage. We hope you and your wife will attend.

Promoting engineering study

Recently made a life member of the American Society of Civil Engineers, **Wallace T. Adams,** 2606 Fleming Rd., Middletown, Ohio 45042, has also been elected a trustee of the Engineers' Foundation of Ohio, a non-profit subsidiary of the Ohio Society of Professional Engineers, of which he is a member. A handsome brochure sets forth the plans for attracting more qualified high school students to the study of engineering as well as the use of the engineering center for aid to students in college and continuing education and community service.

Wally complains that the snowy Ohio winter interfered with his golf so he and Anne took off for a visit to her home town, Rocky Mount, N.C., and continued on to Florida. Next they will spend three weeks traveling through Canada to Vancouver and take a boat trip up the inside passage to Juneau, Alaska. Anne keeps busy at her art work and stamp collection. Wally was elected senior warden of the Episcopal Church of Middletown. He reports seeing Ruth and **Arthur R. Harvey** when they made a Christmas trip to their Middletown home, 101 Kensington St., before returning to their winter quarters at the Four Seasons, 333 Sunset Dr., Fort Lauderdale, Fla. 33301.

Unclassified advertising

Cybertek, Inc., is engaged in developing computerized systems for its laboratory tests. These relate to biomedical services, clinical screening, analyses for physicians, nursing homes, hospitals, research centers, government, industrial and other organizations. **Augustus B. Kinzel** is board chairman with offices at 65 E. 55th St., New York City, and Long Island Laboratories, Inc., Flushing, N.Y., the subsidiary carrying out test work. Gus anticipates establishment of a regional network with an enlarged laboratory near Hightstown, N.J., and satellites to serve Pennsylvania through New England with remote analysis and rapid high-volume processing of biological specimens.

From his home, 1738 Castellana Rd., La Jolla, Calif. 92037, Gus writes a welcome note: "Just to let you know about my new venture. They say the ideal age for starting such an undertaking is 49. My partner is 29; I'm 69, so the average is perfect!" We wish Gus and his associates instant success and steady growth with their challenging project. Let us know whenever you are in Hightstown, Gus; it's a short drive to Brielle.

From Frank Wekel's column in the *Cincinnati Enquirer:* "If you see a 250-pound naked woman . . . sitting side-saddle on a horse . . . chances are good it belongs to **Oliver L. Bardes** of 2627 Grandin Rd., Cincinnati. He had such a copper statue in his front yard until a thief carried it away. Bardes said the statute (sic!) is worth 5,000 bucks." Should the finder return it to its original site, Ollie, or send it south to adorn your new Bardmoor Country Club, 8000 Bardmoor Blvd., St. Petersburg-Largo, Fla. 33540?

Travel expertise

We have reported bits and pieces of foreign trip number 27 which **Saul M. Silverstein,** Chairman of Rogers Corp., Rogers, Conn. 06263, made in October through December, accompanied by Rigi. It took them to Hawaii, Japan, Korea, Hong Kong, the Philippines, Thailand, Malaysia, Indonesia, Singapore, Australia and New Zealand for a series of lectures by Saul, for Rogers business contacts and some side trips for pleasure. Saul has written 23 detailed newsletters with the finest accounts we have ever read—plus his usual terse comments on people and their idiosyncracies. His nine lectures, sponsored by the *Conseil International pour l'Organisation Scientifique,* were delivered at the University of Hawaii, Honolulu; Yonsei University and the Korean Productivity Center in Seoul; also in Manila, Bangkok, Kuala Lumpur and Singapore.

From Honolulu, Saul writes: "We had a nice visit with Catharine and **Harry P. Field** in their plush condominium retirement residence, Acadia Apt. 1137, 1434 Punahou St., Honolulu, 96822. Harry is in much better shape than when we saw him last, but a broken arm, still mending, kept him apartment bound. Wish our classmates would write to him. He sent regards to the St. Laurents and the Clarkes and all on the '21 team. He still hopes to be at our 50th in 1971. Good luck—a terrific couple!" We might add that Catharine also wants to attend the 50th anniversary of her Smith '21 class in 1971. Both Rigi and Saul were ill earlier

this year and we hope this finds both back to normal and planning to join us at Homecoming in June. We are most appreciative of the numerous sets and sheets of unusual stamps which Saul sent us from his ports of call.

Busy observing the 1970 centennial year of his Missouri-Kansas-Texas Railroad, its president, **John W. Barriger, 3rd,** 420 Gimblin Rd., St. Louis, Mo. 63147, probably didn't pause last March 11 to mark the fifth anniversary of his astounding leadership of the road back to its former place of esteem. His 100-hour work week to further the Katy's interests doesn't afford time to reflect upon the series of honors and awards deservedly showered on "Mr. Railroad." Variously termed a rail "giant" and railroading's "miracle man," John received the Golden Plate award from the American Academy of Achievement, Dallas, Texas, for outstanding personal accomplishment in his half-century of railroading. It represents the fifth top honor he received in less than a year. Because of his dynamic personality, progressive ideas and practical approaches, John has won permanent possession of the post of railroading's top executive and spokesman—and the industry has no one to replace the man who has proved his slogan: "Count on Katy."

Retirement relocation

The former president of AMF do Brasil, Sao Paulo, **Samuel F. Chalfin,** who spent earlier retirement in Bermuda, has returned to his native Bay State where he lives at 34 Mugford St., Marblehead, Mass. 01945. . . . **Victor S. Phaneuf,** who retired from the building construction field to become professor of building construction in the College of Architecture and Fine Arts of the University of Florida, Gainesville, has now retired from his teaching post and has a new home at 8351 Candlewood Rd., Largo, Fla. 33540. Read the Campbell-Bartram move to assemble M.I.T. men in your area, Vic—it's mentioned later in these notes. . . . Hexalphas will be interested in a new address for **Raymond C. Fisher:** 5109 N.E. Latimer Pl., Seattle, Wash. 98105. Ray retired in 1964 from the research department of Boeing Airplane. **William R. Ferguson,** President of W.R. Ferguson, Inc., Newark, N.J., and long a resident of East Orange, says he now lives at 174C Main St., Little Falls, N.J. 07424. Does this mean retirement, Bill?

Ralph E. Ferdinand confuses us with a change of his Brewster, Mass., address back to his former home at 60 Preston Terr., Marshfield, Mass. 02050. What's the story, Fritz? . . . **Henry Hutchings, Jr.,** retired brigadier general, U.S. Army, now makes his home at 204C Ruelle St., San Antonio, Texas 78209. . . . **Eugene W. Rudow,** former president of Scientific Supplies Co., Seattle, Wash., is enjoying retirement at Apt. 17, 48-181 Highway 74, Palm Desert, Calif. 92260.

Smiling voices

A phone call to our Class President, **Raymond A. St. Laurent,** 47 Gerard St., Manchester, Conn. 06040, determined that he is rigorously following his strenuous exercise schedule—a walk outside, a flight of stairs once a day and riding his exercycle—and Helen is busy with the additional details imposed by the comfortable first floor extension of their home. Ray enjoys phone calls and letters from the Class. Contact him. He said he just had a call from **Walter J. Hamburger,** 15 Crest Dr., Dover, Mass. 02030, chairman and chief executive officer of Fabric Research Laboratories, Inc., Dedham, Mass., who said he enjoyed the class notes. . . . **Edouard N. Dubé,** Class Agent, 216 Woburn St., Reading, Mass. 01867, reported by phone that Maida is in greatly improved health and he is still maintaining a one or two day-a-week schedule at his Boston consulting engineering office. . . . We also talked to Helen and **Edmund G. Farrand,** Class Agent and Estate Secretary, 5981 La Jolla Mesa Dr., La Jolla, Calif. 92037. Ed says his back has somewhat improved as well as his eye condition. He and Helen are enjoying their delightfully scenic location in their new home.

Florida flock flourishing

In a letter to Ray St. Laurent, mailed from his new retirement home at 9582 141st St. North, Largo, Fla. 33540, **Thomas W. Bartram** tells of meeting retired associates of Ray's from Rogers Corp. He continues: "At Rotary, I talked with the speaker about ozone reactivity. A nearby man facetiously inquired what I knew about chemistry. I asked if he was a scientist and he mentioned M.I.T. and the Class of '21! It was **Elmer W. Campbell** of Course VII from Lovell, Maine, who winters here at 8894 112th St. North, Seminole, Fla. 33540. He wants us to organize a St. Petersburg, Clearwater and Tampa M.I.T. group. Billie and I had a great time with our Class in Mexico two years ago and we'd like to go again."

Muriel and **George F. B. Owens,** P.O. Box 3025, Vero Beach, Fla. 32960, wrote to Helen and Ray in part: "We tried unsuccessfully to reach you from our home in Islip, N.Y. We have now made a major decision to move to Florida permanently rather than try to maintain two places. Betty and **Dug Jackson** spent a weekend with us. They are going to Germany next summer. Ruth and **Irv Jakobson** are coming down to spend a few days. We have a lovely location overlooking the first nine holes of the Riomar Golf Club where we can also see the ocean. If the doctors send you south, our door is always open."

Glenn E. Fargo, 6211 Second St. South, St. Petersburg, Fla. 33705, retired in 1951 from the presidency of Bradshaw Diehl, a Huntington, W. Va. department store and now heads the Fargo Co. He writes: "I keep busy running a personal investment company, playing golf and traveling. Last summer, Helen and I took our fifth trip to Europe. The highlight was an 11-day cruise from Bergen, Norway, to the Norwegian fjords, Spitzbergen and north to the pack ice where we came within 500 miles of the North Pole. We returned via England where we spent a week in London. We found it had deteriorated as has New York City in the last few years. Before sailing from Southampton we visited Winchester, a delightful town in southern England. I called on **Ollie Bardes** at his Bardmoor Country Club here but he was out of town. I have played the course. It is a very good one and the entire condominium development is most attractive. I know the Class is grateful for all the time you spend on correspondence." Thanks, Glenn.

Edward W. Booth, tax consultant and accountant, 261 N.E. Second St., Boca Raton, Fla. 33432, says: "I retired in 1962 to Boca Raton. During the past six years I have built up a modest business in the field of accounting and income tax work. I am now at the peak of income tax preparation for the year. I have had occasion to talk to **Miles Zoller** and also saw **Al Shaughnessy** while he was in Delray Beach. Helen and I go to New England and northern New York State for a couple of months each summer. We certainly hope to be present at the 50th reunion next year. Keep us posted on plans." Good to hear from you, Scripps; tell us whether Al Shaughnessy is making his home permanently in Deerbrook, Wis.

In Memoriam

On behalf of the entire Class of '21, we extend sincere sympathy to the families of four classmates who have left our ranks. . . . **John Morse Giles,** of 911 Live Oak St., San Angelo, Texas 76903, died on January 3, 1970. Born in Amsterdam, N.Y., on August 10, 1898, he attended Amsterdam High School, joining us in the freshman year and graduating in Course XII. He was a member of Phi Sigma Kappa and, during World War I, he served as a private in the S.A.T.C. at M.I.T. He spent most of his life between Philadelphia, where he was active as president of the Giles Dyeing Machinery Co. and its successor, Klauder-Weldon-Giles Machinery Co., and Texas, where he was a successful independent oil producer and operator.

Surviving are his wife, the former Louise Belden of New York City, and a sister Miss Doris L. Giles. Jack often wrote to keep us informed of his doings and phoned frequently when he was in Philadelphia. We appreciate a letter from **Robert E. Waterman,** wintering at 920 Hibiscus Lane, Delray Beach, Fla. 33444, telling us of Jack's passing. Bob adds: "For many years Jack was an avid golfer despite a series of accidents which crippled him extensively and forced him to give up the game. One of my fondest remembrances goes back to 1938 in Augusta, Ga., when he handed his cane to the caddy, took out a four wood, and got himself a hole in one. He was my last close link to the Class, a grand guy, and I shall miss him." We have a warm letter from Louise who, we hope, will attend our 50th. She thanked the Class for its expression of sympathy and requested retention of her name on the class roster, saying: "We were disappointed not to get to Homecoming last year at the time of

our trip abroad and I'm doubly sorry that Jack didn't get the chance to visit with his many friends. He was so proud of his association with the Class of '21. Thank you for your comforting letter."

Arthur Randolph Gatewood, of 106 E. 35th St., New York, N.Y. 10016, died on January 15, 1970. Born in Philadelphia on November 6, 1899, and raised in Newport News, Va., Liz earned a bachelor's degree in civil engineering at Virginia Military Institute and joined us in the sophomore year, graduating in Course XIII. A member of Kappa Sigma and Theta Tau, he was active as an undergraduate on the Institute Committee, the governing board of the Technology Athletic Club and as secretary and chairman of the Naval Architectural Society. He was awarded the David W. Taylor Medal in 1963 for "notable achievement in marine engineering," the highest honor bestowed by the Society of Naval Architects. Surviving are a brother, Richard L. Gatewood, M.I.T. '25, of Atlanta, Ga.; three sisters, Mrs. Elizabeth G. Pietsch, M.I.T. '22, of Denver, Colo., Mrs. Mary G. Bell and Mrs. Harriet G. Sibley. **Irving D. Jakobson** receives our thanks for sending information and a letter saying, in part: "Arthur Gatewood and I were quite close since we were together in Course XIII and we maintained contact through later years. It is with sincere personal regret that I received news of his passing." We also have a fine personal note from Arthur's brother, Richard, in reply to our letter to Mrs. Pietsch, who is currently hospitalized.

Harry Rosenfield, of Brooks House, 33 Pond Ave., Brookline, Mass. 02146, died on January 26, 1970. He was born in Boston on June 13, 1900, and prepared for the Institute at Mechanic Arts High School. At M.I.T. he was a member of both the wrestling and boxing teams and the wearer of the TWT and TBT. He was a private in the S.A.T.C. during World War I. Rosie was graduated with us in Course X and founded the National Laundry Co., Dorchester, Mass., retiring as its president in 1965. Surviving are his wife, the former Ruth Levy of Boston; a son, Jay Rosenfield, Dartmouth and M.I.T. '51, of Marblehead; three daughters, Mrs. Roberta Hoffman of Waban, Mrs. Joan Eliachar of Wellesley Hills and Mrs. Wilma Kagan of Newton; two sisters, Mrs. Sara Rosenthal of Newton and Mrs. Betty Levy of Boston, and 11 grandchildren. We wish to thank Mrs. Rosenfield for her welcome note of appreciation for the Class expression of sympathy and saying, in part: "Please keep my name on the class roster. M.I.T. meant so much to Harry and therefore to his family."

Webster Kimball Ramsey, of 18 Damon Rd., Holden, Mass. 01520, died on January 30, 1970. He was born in Manchester, N.H., and came to the Institute from Chauncy Hall School. At M.I.T. he was on the finance committee of the Institute Committee, class champion in freshman wrestling, member of the class tug o'war team that defeated the freshmen at Field Day, Chauncy Hall Club, Aero Society, Mechanical Engineering Society and its treasurer and the Civil Engineering Society. He leaves his wife, Mrs. Chrystella A. Ramsey; two daughters, Mrs. June Atwood of Sudbury, Mass. and Mrs. Carol Rice of Shrewsbury, Mass.; a sister, Miss Geraldine Ramsey of St. Petersburg, Fla., and two grandchildren. We are indebted to **Robert W. Haskel** for sending information with a letter saying, in part: "I was greatly saddened to learn of Web Ramsey's passing. He and I were together until 1922. For three summers we operated motor boats on Squam Lake for the Perkins Boat Livery, Holderness, N.H."

We strongly urge you and your wife to "Join '21 in 'Seventy-one!" Meanwhile, please write us some news for these columns.—**Carole A. Clarke,** Secretary, 608 Union Lane, Brielle, N.J. 08730; **Edwin T. Steffian,** Assistant Secretary, Steffian, Steffian and Bradley, Inc., 19 Temple Place, Boston, Mass. 02111; **Sumner Hayward,** Assistant Secretary, 224 Richards Rd., Ridgewood, N.J. 07450

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There should be some promises made or a rule promulgated about Class Secretaries staying at their desks long enough to file intelligent, instructive and interesting reports. But here go the Fergusons to Abidjan, Johannesburg, Cape Town and Nairobi with noticeable neglect but no regrets. The Buffalo Chamber of Commerce Trade Mission has priority, as it is our duty to present golden buffaloes and locally manufactured products to African officialdom.

In the meantime we have found that **William Schulman** of Baltimore has been named Technical Director for Fuld Brothers of Baltimore, Md. Before joining the chemical specialty firm, Bill had been directing technical operations at Chemical Services, now a division of Imoco-Gateway Corp. He has been responsible for many of the recent developments in waxes, detergents, disinfectants and aerosols. He instituted advanced technology for polymer finishes for polishes and coatings. . . . **Roy A. Stone** writes from Danbury, Conn., giving the winter back to the Indians and Eskimos—otherwise he is fine. . . . **Harmon A. Poole** of Litchfield, Conn., enjoys seeing many M.I.T. people and will look up others in Tucson, Ariz. this winter. **F. Willett Walton, Jr.,** writes from Stamford, Conn., that he is going strong and is still called "Luke."

Harry R. Kimball from Course VI has been complimented in Washington for his book that is "not a scholarly treatise, nor even a theological exercise but rather an application of reason and common sense." He is retired and lives at Miami Beach, Fla. He questions orthodox religious beliefs in his *I'll Be Damned* published by Vantage Press of New York. He sums up a few of the conclusions of liberal scholars in his exposure of biblical contradictions, confusions and absurdities, both in the Old and New Testaments. He begins by recapitulating the beginning and the development of Judaism and also talks of the origin of Christianity and the New Testament. Harry was born in Poland, the product of an orthodox religious atmosphere.

The *Scientific American* has published "How Birds Sing" by **Crawford H. Greenewalt** telling of tracheal attenuation and resonance with drawings of the highly evolved syrinx of songbirds. The mechanism of bird song has been compared to either wind musical instruments or the human vocal apparatus. The analysis of bird songs themselves points toward an entirely different system. Crawford explains these theories in a most interesting article which supplements his book, *Bird Song: Acoustics and Physiology* (Smithsonian Institution Press, 1968)

Of interest to all is the announcement of the wedding in Barbados on December 31, 1969 of Dorothy P. McClennen of Phoenix and **Abbott L. Johnson,** Chairman of Warner Machine Products, Muncie, Ind. Present for the ceremonies were Dorothy's daughter Emery, age 12, and Abbott's daughter and her husband, Mr. and Mrs. James N. Douglass of Muncie, and their four children. They will be at home at 80 Warwick Rd., Muncie, during the spring and summer. Jack and Hardy Liecty of Phoenix have worked on some civic committees with Mrs. Johnson and Herb Fales and his wife have moved into the same apartment building in which she lived. The new Mrs. Johnson met many of our Class at Buck Eacker's birthday party in December, including the Chitticks, Appels, Dandrows, Bob Tonon, Warren Ferguson, Roscoe Sherbrooke, Fearing Pratt and others. Abbott promises to bring his bride to Alumni Day next June where we will have the pleasure of becoming better acquainted.

The sympathy of our Class goes to the families of **Stanley M. Ryerson,** who passed away on November 23, 1969 and **Joseph H. Flather** of Sarasota, Fla., who died on November 27, 1969.

We are indebted to Cac Clarke, '21, for an item regarding the death of **Leslie D. Price** of South Harpswell, Maine. He was a retired safety consultant on engineering standards for national and international industrial standardization and local, national and international electrical safety standards and regulations. He was with the Public Service Electric and Gas Co., of Newark, N.J., for 23 years after graduation and then joined the engineering and safety regulations department of the National Electrical Manufacturers Association as manager.

And now with a trigger happy finger on the release button of the Retina and a change of telephotos, off we go to represent our famous Class and Buffalo in the land of the lion and the elephant. See us in June for the complete photographic South African survey.—**Whitworth Fer-**

guson, Secretary, 333 Ellicott St., Buffalo, N.Y. 14203; **Oscar Horovitz,** Assistant Secretary, 45 Gerard St., Boston, Mass. 02119

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From **Roger Cutting** we learn that he has written and recently had published a book titled *Motor Mania* by the Rand Press. All proceeds will go to the Larz Anderson Museum for Antique Cars in Brookline, Mass. He says: "It is a story about some 60 years' experiences with automobiles, but not in too technical a vein. Numerous illustrations are included, as well as quite a few auto-based anecdotes from my years at M.I.T." It sounds good, Rog, and we will try and get a copy soon! In another letter Rog goes on to say, "Am pretty much retired although I still do fiduciary work for a few relatives and close friends (trustee and investment counsel). Have office space in Boston . . . spend most of my time on Cape Cod. A tricky knee has put 'paid' to my golf, but I raise quite a few flowers and fish a lot (trout mostly). Also talk to my assorted birds, rabbits and squirrels (fortunately the latter prefer real 'nuts' to the auto variety.)"

From **Pete Pennypacker** who has been corresponding with **Samuel L. Williams** we learn that Sam had run across an old, old newspaper clipping from the *Boston Herald* (probably November 1919) concerning certain disorders that broke out at the theatre in Boston upon the occasion of Tech Night. The show, the name of which neither of us can recall, starred Irene Bordoni and Sam Bernard. Both of us recall the streams of paper directed at the stage, one of which nearly hit our friend Irene and which caused Sam Bernard to make his famous speech of admonition which I recall caused the ebullient crowd of embryo engineers to quiet down and subside. The event was the evening of Field Day and Sam Williams recalls how Pete organized the famous band of the Class of 1923 with Sam playing the cymbals "mostly at the wrong time." This, of course, proves that we of 50 years ago could also raise a particular type of cain but not for the same reasons as today. We do think, however, that there was not too much idealism behind what we did then, but then again we may be wrong. Let's have some reaction to our thinking, classmates!

Again due to the cooperation of Pete we have at hand a letter from **Art Stuckey** to him which says in part: "My wife and I are thankful for relatively good health and take reasonable precautions to see that it continues. A cataract operation will be necessary for me one of these days . . . So far I can read pretty well and drive in the daytime but my wife insists on all driving at night. We manage to keep busy . . . (but) . . . my rate of production, including letters is getting slower and slower. Have six months work ahead of me (on the house) . . . Just now have the 16-year-old brother of our foreign student with us. . . ." Good work Art! Is your student A.F.S. or Rotary? We are actively engaged in the Rotary International Youth Exchange Program here in Danbury, Conn., and find this work most rewarding.

Herb Hayden has regaled us with a map of his last fall's lengthy trip to Africa. Peripatetic Herb, still twice weekly hockey-playing, began his trip on September 26 to Athens, thence to Ethiopia, East Africa, South Africa, West Africa, the Canary Islands and Madeira, returning to the States in early December from Lisbon. We envy the Haydens and their sight and sound sensing of the dynamically developing new nations of that "Dark Continent." Herb, who is promoting the "Telethon" fund-raising project at the Institute on March 17, sent along a letter from **Bertrand A. McKittrick** who is forced to beg off due to his impending trip to Florida and cruise through the Caribbean to Curaçao. Among other things, he says, "In June I am taking two grandsons (12 and 16) on a two-week canoe trip out of Ely, Minn., which will be partly in the Superior National Forest (USA) and partly in the Quetico Provincial Park (Ontario). Am planning on a guide to do all my heavy work but the boys 'need the experience'."

From our M.I.T. Office of Public Relations we see that **Nathaniel H. Frank,** former head of our Department of Physics, in his vice-presidential address to the physics section of the American Association for the Advancement of Science recently pointed out that physics experiments that fail can have special educational value. He said at one point, "The single-mindedness that prevails as to a 'successful' outcome of a physics laboratory experiment has often limited sharply for the student the invaluable learning and insight that is acquired by the designer in 'debugging' an experiment so the expected will occur." We have often wondered along this line of thinking. Perhaps we can bring to mind an old adage that says that sometimes we learn more from our failures than from our successes. Glad you said those most interesting things, Dr. Nat in your address.

Bertram E. Warren, professor emeritus and senior lecturer in our Department of Physics, was the first recipient of the George W. Morey Award of the American Ceramic Society last September. Dr. Warren has written some 120 papers on the structure of silicate materials, measurement of order-disorder of binary alloys, the structure of carbon black and the process of graphitization and the structure of amorphous materials, including glass. He is vice president of the International Union of Crystallography.

Harry Kalker tells us: "I am entering the third year of retirement from the presidency of the Sprague Products Co. We travel six months of the year and enjoy Williamstown, Mass., the remaining six. Before retirement I was co-founder of the First Colony Life Insurance Co. of Virginia that reached the billion dollar inforce figure in December '69. Six grandchildren keep Mrs. Kalker and me busy during the summer months. Looking forward to our 50th reunion." . . . **Raymond M. Meekins** writes: "Busily retired on a 3-acre Fairfax County, Virginia estate . . . We are both involved in gardening. Minor evidence of aging but pretty much in good health." . . . **Scott V. E. Taylor** states succinctly, "Nothing of interest except that a good idea may have percolated into my head late in November." You leave us in a state of suspense Scott. Can't you tell us now?

Thomas L. Powers writes—"Still at the Powers Hotel in Fargo, North Dakota." You are the soul of brevity or a great humorist, Tom. Please tell us more.

J. S. Keenan advises: "Retired vice president of Canadian General Electric Co. Works part time as management consultant." Or, maybe it was somebody else doing the advising. Can't you tell us more?

We are extremely sorry to hear of the death of **Kilburn Miller Smith** in Ft. Lauderdale, Fla., late last year. He had received the award of Fellow of the I.E.E.E. "for contributions to the field of power systems engineering, particularly in the pioneering of high-voltage transmission of bulk power in densely loaded areas."

Now, having submitted a substantial amount of copy for this issue, I will subside for another month. Hope I still have readership!—**Thomas E. Rounds,** Secretary-Treasurer, 4 Deer Hill Dr., Danbury, Conn. 06810

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Before we forget it again, **Russ Ambach** has asked several times for a small spot of advertising space. He has four of those pewter mugs left over from the 45th, and he wishes to announce that he can be persuaded to part with them for eight dollars each on a first-come first-served basis. Rush your orders to Russ at 135 Aspinwall Ave., Brookline, Mass. 02146.

The traveling **Ray Lehrer**s are at it once more. The places they haven't been get fewer and fewer each year, but they still seem able to come up with something new and different. This winter it's the Far East, and although they have been to some of its rather exotic spots before, for some reason they seem to have missed the Philippines. In Manila they looked up **Emilio del Prado** and "met most of his fine family, 31 grandchildren in all. Does that push the Cardinals' record?" Not only pushes it, but tops it by eight. Del plans to retire from teaching at Feati University at the end of this year. Two of the grandsons have their eyes on M.I.T., and Ray passes on the good word that the del Prados plan to join us at our fiftieth. Reunion Chairman Cardinal will no doubt come up with some appropriate form of recognition.

A news item from the *Hudson Dispatch* announces that **E. Curtis Plant** has been promoted to the post of assistant to the manager of system planning, Public Service Electric and Gas of New Jersey. He had been forecasts engineer before that. The item also listed Curtis's (maybe you will remember him better as "Egg") many and varied interests, and it runs on at considerable length—banks, a hospital, boys clubs, a community orchestra, church—you name it. Curtis has been a very busy man through the years.

Last December the New York Academy of Sciences awarded a citation which read in part as follows: "Whereas, **Gordon Y. Billard** has served the New York Academy of Sciences as a Member of the Finance Committee, Chairman of the Finance Committee, Member of the Council, Member of the Board of Trustees, Member of the Board of Governors, and Treasurer, therefore be it Resolved . . ." and here it goes on to express the gratitude and appreciation of the board of governors for Bill's eminent services over a period of 20 years. A very impressive tribute.

Sorry to have given the impression that **Chris Conway**'s working years were sedentary ones. AT&T and Bell of Canada cover a lot of territory, and Chris was constantly getting out into the territory. In fact, several years ago both United and American Air Lines awarded him certificates for long air mileage. The only real change in his travel habits is in making long trips on the ground instead of by air, and in having Mrs. Conway for company. This summer they're leaving Louisiana for a bit to "bask in nature's air conditioning" in Kennebunkport, Maine, and to go on a binge of "those succulent lobsters."

Nuptial of note: Last December in the National Cathedral at Washington, D.C., **Mitchell V. Allen**'s son, George S. Allen, M.D., at the moment a Lieutenant Commander in the Public Health Service, and Miss Carol Eakin were united in holy wedlock. Carol is a niece of Milton Eisenhower's, so he and all his family and Mamie Eisenhower were on hand. Suppose that's our equivalent of Canterbury Cathedral wedding with the Queen Mother present.

We told you recently that **Charles R. MacBrayne** was enjoying faraway places, once removed, by being in the travel business. Charlie has always been a convincing feller, and evidently sold himself on the joys of travel, because recently he made a three-week trip to California. Then, coming back, he detoured a bit to catch up on some of his fellow miners, a small but clannish group.

First stop was Sun City, Arizona, to see Clem and **Don Kennedy** and their guests —a surprise for Charlie—**Atherton** (Jack) **Weston** and his wife. In addition to being fellow miners all three were at the Fisher's Island ROTC camp in the summer of 1923, so a pleasant evening was spent poring over Don's old snapshots. Jack has spent his entire working life in the Southwest and is living in Phoenix, but the Kennedys went out there only after Don retired from the Bureau of Mines in Washington about three years ago.

Next stop was in Santa Fe to see Marvel and **Hugh Craigie.** "They live on a mountainside at the edge of town and have the most beautiful view imaginable. The air is so clear that we saw a mountain 90 miles away. Pollution is just a new word in the vocabulary out there. Hugh, who is as handsome as ever, has just retired as president of United Nuclear, a big uranium mining outfit. He is still on a consulting basis and puts in about half time at his convenience." Charlie was planning to spend Easter in Florida. Don't know what the concentration of miners is down there, but if there are any he'll track them down—and send the news to your Secretary. Wish more of you would do the same.

Frank R. Fahrion received his masters in navy ordnance with us. He had an outstanding and varied career during W.W. II, primarily in the Pacific from the Aleutians to the Marshalls and the Philippines. He retired some years ago as an admiral, and on January 16 died in La Jolla, Calif.

Samuel D. Waxman was with us only a year as an undergraduate. He had lived in Boston all his life and had been in the printing business. He died on February 3. To the families of both of these classmates go the sympathies of all of us.— **Henry B. Kane,** Secretary, Box 177, Lincoln Center, Mass. 01773

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The 45th reunion will be less than a month away by the time you read these notes; but if you have not as yet made your reservations or notified Ed Kussmaul, there is still time. You will miss meeting with many of your friends if you fail to make the reunion.

Some news clippings bring us interesting information regarding **Ben Oxnard** who in February received the most desired prize in the sugar industry—the Dyer Memorial Award as "Sugar Man of The Year" for 1969. The award was presented at a luncheon at the India House in New York City and recognized the winner's meritorious contributions to the sugar industry with this citation: "Ben Oxnard's contributions to the sugar industry growing from his deep family roots therein, brought to the industry a moving, vital force in sugar marketing, in packing and in historical significance." One of the articles provided information regarding Ben that I do not believe many of us knew. In 1937, he revolutionized the trade by perfecting the multiwall paper bag and bundle which replaced the 100-pound cloth sack for sugar. In 28 years with Great Western, he directed the marketing of more than 26 billion pounds of beet sugar. He retired in January 1969, having begun his career in 1924 in Georgia with Savannah Sugar Refining Corp., a company his father founded. His grandfather planted cane in Louisiana in 1840 and later operated sugar plants in Boston and Brooklyn. Three uncles pioneered the western beet sugar industry around 1900, building a factory at Scottsbluff, Nebraska. Ben's son, Benjamin, Jr., is financial vice president of National Sugar Refining Co., New York. Ben's name has come up several times in the past few weeks. A few days ago, a telephone call came from **W. R.** "Rusty" **Blair** who is planning to attend the reunion, and Rusty was making some dire threats against Ben, such threats to be carried out if Ben fails to attend the reunion! We have every indication that Ben will be with us at Bald Peak in June.

A letter from **Masaru** "Kammy" **Kametani** notes that both he and his wife, Hisako, will be at the reunion. This will be her first trip to the U.S.A. Kammy notes that she will wear a Japanese kimono all the time, and he may also appear on the campus on June 15 wearing his kimono.

There were a number of army and navy officers attached to the Class of 1925; and many of them, such as Major General **J. L. Holman,** were with us for a relatively short time. General Holman was with us only from September 1924 through July 1925, but it was a pleasure to hear from him and to learn of some of his activities. After 1925, he remained in regular service in the Army Ordnance Corps and in World War II served as chief ordnance officer in the Southwest Pacific, as well as serving in many other offices of high command. He was the commanding general in the Aberdeen Proving Ground in Maryland and retired as a Major General on June 30, 1956, after which he moved to San Antonio, Texas, where he has been located since that time.

A release of the American Meteorological Society dated February 12 noted that the Society presented its annual awards at an honors luncheon held at the Washington Hilton Hotel on that date. The award for outstanding contributions to the advance of applied meteorology was conferred upon **Arthur F. Merewether** "for his leadership in aviation meteorology and for his effective application of meteorology during World War II." Colonel Merewether was the originator of the Air Weather Service and is a retired manager of weather services for American Airlines. He retired in 1966 after developing an outstanding aviation weather service which helped pave the way for jet age aviation and which contributed greatly to the air lines' safety record.

On a recent visit to the Capitol City, it was my pleasure to call upon **George L. Washington** who is the director of the College Service Bureau, a new organization which he helped to set up and get under way in October of 1969. In his

present position, he is responsible for providing services to nearly 80 colleges in the United States.

I am extremely sorry to have to announce the death of **Theodore G.** "Ted" **Coyle** in Norwood, Mass., on February 2, 1970. All of you will remember Ted as one of the stalwarts of our wrestling team back in the 1920s. Upon his graduation he became associated with M&T Chemicals and was best known for his work as technical director and vice president of the company's chromium electroplating operations and for his pioneering research in chromium plating technology. During most of his active life, he was with United Chromium, Inc., a subsidiary company of M&T Chemicals, serving as its vice president from 1945 through 1957, at which time it consolidated fully with M & T Chemicals. He then became executive advisor to M&T's marketing and international groups, a position he held until his retirement in 1962. Ted was a leader in both the chemical and electroplating fields and was heavily involved in a number of technological societies. The sympathy of all members of the Class of 1925 is extended to his wife, Mary Alice, and to their four children.—**F. L. Foster,** Secretary, Room 4-144, M.I.T., Cambridge, Mass. 02139

26

Having wandered into the "Letters to the Editor" last month we will get down to earth (sea-level plus thirty feet) and talk Class of Twenty-six. I'm even going to step out of the picture this month and let the Class talk since there is a nice accumulation of letters.

Larry Cumming wrote us some time ago from his new retirement location in Victoria, B.C., Canada, which is about 80 miles NNE of Seattle, according to the map Larry sent, but let Larry tell it: "I have retired from active I.E.E.E. staff work at N.Y.C.-H.Q. but still consult for U.S. government and Canadian companies. We have owned this waterfront duplex for over ten years and decided to try living here; the weather is ideal, though windy in winter; our lowest temperature to date 38° and salt water temperature varies less than 10° between summer and winter (40°-52°). Victoria is known to be Canada's 'banana belt'! We had 82-mile gusts in a storm but the boys were sailing and golfing the next day and roses are actually still out. We rented our house in Wilton, Conn., for two years and the apartment in N.Y.C. for three years, giving ample time to decide on the west or east coast. Must admit however, that the west coast from here to Santa Barbara offers the most tempting living, 12 months per year—outdoors. You all must visit us."

A letter from **Dwight Woods** is headed "Somewhere in North America" but was mailed from Texas. Let's quote him: "Dear George: I have been remiss in keeping you posted through the years. After 43 years in the gas business with the same company, I retired in July 1969. My wife Clemmie and I had been looking forward to that day and had been making plans for several years. We have rented our house in Old Hickory, Tenn., for at least a year. We left Tennessee during my vacation in mid-June in a 29-foot Airstream trailer hauled by a ¾-ton Chevrolet suburban truck with the idea of living in the trailer as long as we felt like it and to see the country (not the cities) west of the Mississippi with contemplated trips to Mexico and Alaska later.

"We have been on the road for over six months and are more convinced than ever that this is the way to see the country. We have no schedule, travel when we want, and make up our minds on the spur of the moment. When we move it is not in a big rush, for 300 miles is a big travel day. We have been from the panhandle of Florida to the Olympic Peninsula in Washington and down the Pacific Coast to Ft. Bragg, Calif. From there, our progress has been somewhat hurried to stay ahead of cold weather as we headed south and east through Nevada, Arizona, New Mexico and Texas to Big Bend National Park. In early February we take off with 75 other units into Mexico for five weeks. There is a good possibility that we may attend the 45th reunion in 1971 for we wish to see the coast of Maine and the Canadian maritime provinces."

A letter from **Ed Huckman,** also retired, will just about use up our space. "Dear George: Thanks to your reporting we were able to have breakfast with Dave and Doris Powers when we flew into Phoenix on a trip to Grand Canyon, Los Angeles, Yosemite, etc. Sorry the Arizona reunion of the Class of '26 didn't materialize! Best regards and looking forward to the next '26 reunion, Ed Huckman—P.S. This retirement is hard to beat. We are enjoying doing things there never seemed to be time to do before."

This really is fun—writing up the retirement exploits of our classmates. I'm sure there are some interesting and diverse ones still to come out of the woodwork. We would enjoy hearing about yours! We hope to see many of you at Alumni Day; and the evening of June 14 it will be M.I.T. at the Pops with Arthur Fiedler in Symphony Hall, and if we are to have '26 tables we must have early reservations. Cheerio until June—**George Warren Smith,** Secretary, Pigeon Cove, Mass. 01966

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When I agreed to fill in for Joe Harris during his trip to the Orient, I asked him to keep me posted on his travels. As a result, he has made things easy for me by supplying the greatest part of this month's notes. Joe is travelling on the cargo liner *Orient Pearl* of the Orient Overseas Line (owned in Nationalist China), formerly the *Exeter* of the American Export Line. There is apparently a subtle difference between a "freighter" which carries no more than 12 passengers, and no doctor, and a "cargo liner." Joe's ship is carrying 60 passengers and a doctor, plus cargo.

Joe writes: "All the passengers are Americans, and all tourists except for four missionaries headed back to their jobs. Necessarily, most of the passengers are retirement age, but there is one young family of four, including two teen-age boys, who are going around the world. Many are experienced 'freighter travellers'.

"We picked up a load of bleached wood pulp, in bales, at Eureka, Calif., and have delivered them in part to barges at Yokohama and Kobe, Japan. Now we are on our way to Inchon, South Korea, to unload a shipment of cotton bales.

"Yokohama, the port, and Tokyo, the largest city in the world, fitted all the descriptions we had heard. They are both highly industrialized. It was a real treat for anyone used to commuting on the New York Central to take the Bullet train from Yokohama to Kyoto. In 2nd class, the cars were comfortable and absolutely clean; doors between cars operated by electric eye; the roadbed makes it unbelievable that the speed is so high. In Kyoto, we did something no visitor to Japan should miss; we spent the night in a ryokan, or Japanese inn, where we had dinner served Japanese style and slept on the floor matting. A charming experience." Joe is going on to Taiwan and Hong Kong, where he will spend two weeks, then back to Japan in time to take a look at Expo 70. He has promised to write again from Hong Kong.

Joe received a letter from **Paul Vaughan,** who retired in 1968. Paul says, "Finally found a spot here in Toms River, N.J., with a natural waterfront. I designed the house and had a contractor build it. It is not quaint or 'picture-skew' but it is practical—looks like it was designed by a 'damn engineer'. The water is just 40 feet from the house, and the sailboat is moored there, so I have enjoyed sailing into mid-November. But as of January, 1970, I have taken on a 6-month assignment as manager of engineering for a concern in Sydney, Australia. It is now summer in Australia, and Sydney has magnificent sailing. When I get back, I will still have half the summer here. My wife Helen hopes to join me shortly after I get located. It will be her first flight—temptation overcometh fear. Now it is back to the hard life for a while —getting up before 9, and no two-hour naps in the afternoon. Paul S. Vaughn, 74 Green Island Road, Toms River, N.J."

Dean Bisplinghoff of the School of Engineering has announced that Professor **Charles Kingsley, Jr.,** will be among those associated with Dr. Herbert H. Woodson, just appointed director of the newly-established Electric Power Systems

Engineering Laboratory.—**Joseph H. Melhado,** Acting Secretary, 24 Rodney Rd., Scarsdale, N.Y. 10583

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We suspect that many of our good classmates remain unheard because of some belief that to write requires preparation of a long, careful autobiography. A detailed report is always very welcome, of course, but it is more important that we hear from everyone. Your correspondence need be no more than a jotted sentence or two. Much of our class news comes in just such short flashes: From **Charles Hemminger**: "Having retired as senior research advisor from Esso Research and Engineering Company, I moved to the country at Peapack, N.J. Am continuing as a consultant, however." . . . A note from **Ethel R. Yood** (Mrs. Bernard) tells us: "I resigned from Brookline, Mass., Public Schools in June, 1969. Am now supervisor of field experiences, Elementary Education, Boston University."

W. Grier Armstrong writes: "Expect to be retired by the du Pont Co. pigments department in October, 1970." We happen to have a copy of a paper by Grier, "Some Ideas on Dispersing Titanium Dioxide in High Speed Dispersers" which was published in the March, 1969, *Paint Technology*. To our innocent eye, Grier's paper appears to be a very competent treatment of the subject. . . . **Charles W. Ricker, Jr.,** gets a lot of message into very few words: "Now chief equipment engineer of Chicago Transit Authority. Three grandchildren (daughter's children) make me feel a bit older. My son, now out of the army (was a first lieutenant), is with I.B.M. I enjoyed very much a four-week trip to Japan in 1968 and will go this year on a cruise in the Caribbean."

The month's award for brevity must go to **C. Henry** (Harry) **Conroy:** "Retiring Oct. 31/70." Harry is chief engineer, Department of Public Works, Newfoundland. He is located at St. John's. . . . From **Walter Anderson** we learn that he is now retired from Simplex Wire and Cable Company where he was manager of the materials laboratory. Walter reports that he suffered a heart attack in 1967 that put him in the hospital for a month. He recovered fully and returned to work. When his company decided to move to North Berwick, Maine, Walter chose to take early retirement. Just now the Andersons are busy preparing to move to Harwich, Mass., where they have bought a home as their retirement spot. Walter's daughter Judith has three children. His son Warren has finished his tour of duty with the navy and is now with Honeywell, Inc. in Billerica, Mass.

Mary Nichols (Mrs. Arthur A.) has been in the news several times lately. On the occasion of the 65th anniversary of the founding of W. H. Nichols Company, Mary unveiled portraits of Art Nichols, his brother Hart, and their father, W. H. Nichols, who founded the business. Art, at the time of his death in 1968, was president of the firm. Mary has chaired several large and successful bloodmobile programs for the local chapter of the American Red Cross in her town of Weston, Mass.

Our esteemed classmate, **Carl M. Loeb, Jr.,** is national president of the National Council on Crime and Delinquency. This volunteer non-profit agency seeks to tackle the problem of crime by helping communities to upgrade their systems of criminal justice. This group represents a strong, organized and professionally guided effort by thousands of responsible citizens across the nation. Carl would be very pleased to hear from any of you and to have your support.

George Chatfield, who was the class Secretary for many years, operates his own commercial radio station, a Muzak agency, and a newspaper, the *Montachusett Review*. All of these are in Fitchburg, Mass. From Marie Chatfield (via Florence Jope) we are informed that George is one of the directors of the new Fitchburg Ciné Center. He was one of the planners for the opening week program of that center. Performances by Arthur Fiedler and the Boston Pops featured the two opening nights. The house was completely sold out for both nights to a total of over 9,000 attendees. We might wonder if George's years in the advertising business could have had anything to do with such a resounding success.

The Associated Industries of Massachusetts last year presented to Artisan Industries, Inc. and to Jet-Vac Corporation (both of Waltham, Mass.) separate awards of achievement. These were in recognition of the part each company played in the Apollo program that culminated in the spectacular moon landings. **Jim Donovan** can take justified pride in these honors. Both firms were started by Jim under difficult conditions. Their growth has been due, in no small measure, to his intense effort and complete dedication to them.

Jim is still our best reporter. Much of this comes as a result of his business activities and travels. Those with whom he has had recent contact include: **Ed Walton** (Ed's correct zip code is 10510); **Melvin Sack,** presently manager of the heat exchanger division of Henry Vogt Machine Company in Louisville, Ky.; **Bill Gorfinkle,** who is still busy producing gelatin and continues to improve his plant; and **Des Shipley,** who is planning trips to Alaska, Japan, and all around the United States after having flown most of his life in the air force and as an American Airlines pilot! . . . **Dave Olken** is another classmate who is in occasional touch with Jim. Apparently Dave's two sons are in the business with him and Dave seems to be hard at work as always.

Business strain finally convinced **Walter Nock** that he should move away from Mexico City to the United States. His company, Cia Minera Asarco, S.A., asked that he remain in his official capacity to supervise operations. As a result Walter is now spending only one-third of his time at work in Mexico. Meanwhile he and Lela are enjoying the change of pace. Their son Walter is with the First National Bank of Chicago in the international division. He completed his two years of military service then obtained his master's degree in business administration.

We have had a note from Don Severance who saw **Ray Wofford** at a recent M.I.T. club meeting in San Diego. Don reports that Ray is looking real well. . . . **Charlie Worthen** is most anxious to see improvement of Twenty-eight's participation in the Alumni Fund. If you have not yet sent in your contribution we urge you to do so. Finally, we hope that many of you will be able to attend the M.I.T. Homecoming weekend activities on Sunday, June 14 and Monday, June 15. This year we are promised a marvelous program of events!—**Walter J. Smith,** Secretary, 209 Waverly St., Arlington, Mass.

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I deeply regret to announce the sudden death of **Elmer A. Skonberg,** Course XV, of Louisville, Ky., on January 15, 1970. Elmer was one of the most congenial and friendly members of our Class who supported all our activities with wholehearted enthusiasm. He attended our recent 40th reunion and showed by his actions that he was enjoying his well-earned retirement. Many of us got a big laugh out of a "business" card he had printed which said: "Elmer A. Skonberg—Retired. No Business—No Phones—No Prospects—No Money. Just having a good time."

He was active in alumni affairs and participated in many community projects in his home town. He was a volunteer worker in the Small Business Administration and was a charter member of the Audubon Kiwanis Club. He is survived by his wife, Ollie and a brother, A. W. Skonberg.

Hugh G. Hamilton, Course IX-B, of Durham, N.H. and Boca Raton, Fla., suffered a stroke early in January, shortly after he arrived at his winter home. The stroke, which his doctors described as massive, left Hugh completely paralyzed; he could neither speak nor swallow food. My wife and I visited Hugh and Helen last week (March 11) and I am happy to report that he has made a miraculous recovery. He is now able to speak, eat and walk with a little assistance and his mind is as keen as ever. Helen would like their many friends to know that the Hamiltons will not return to their home in Durham this summer but will remain in Florida the rest of this year.

Hugh has always been very active in alumni affairs. He is presently Estate

Secretary for our Class. In his biographical sketch, he relates that his first job after graduation was with Hygrade Lamp Co. which later became Sylvania Electric Products. In 1935 he joined the Pioneer Division of Bendix Aviation, manufacturers of aircraft instruments. In 1940 he organized his own company known as Eastern Air Devices, Inc. which manufactured aircraft instruments in the New York area; the company proved very successful and was listed on the American Exchange. In 1953, he moved his plant to Dover, N.H., and later sold his interest but managed the company until his retirement in 1962. Hugh has also been active in community affairs. He has been chairman of N.H. State Port Authority, a member of N.H. Council for Foreign Trade, president of Dover Chamber of Commerce and trustee of Stratford Savings Bank. The Hamiltons were married in the fall of 1929 and they have five children and seven grandchildren.

A news item in the Portland, Oregon *Journal* reports **Arthur Scott,** Course X-A, debating a timely topic, "Are nuclear power plants proposed for Oregon safe?" Arthur is director of the Reed College Reactor Facility and the chairman of the Governor's Advisory Nuclear Development Coordinating Committee.

A brief note comes from **Louis F. Southerland, Jr.,** of Austin, Texas, stating that he is a member of the firm of Page, Southerland & Page, Architects and Engineers, practicing since 1935, doing mostly commercial and public buildings.

Alfred H. Hayes, Course X-A, who retired last fall from the Standard Oil Co. (Indiana), after 38 years of service, is back in business again as director of cooperative education at St. Joseph's College Calumet campus. He will work with a dozen area businesses and industries who employ nearly 50 students under the Cooperative Education Plan. Alfred started to work in the research department of the Whiting Refinery in 1930. He transferred to the operating department in 1934 where he became general foreman of the pressure still department and of the crude still department and later general superintendent of the Whiting Refinery. In 1960 he transferred to the Chicago office until his retirement in 1968.

A news item from Eastman Kodak Co. in Rochester, N.Y., announces the retirement of **William J. Knox, Jr.,** after 25 years of distinguished service. His retirement, however, does not mean he's heading for the rocking chair, for Dr. Knox plans to devote all his available time to achieve better racial relationships between black and white. Here are some of his thoughts and statements on this timely topic: "Integration, not separatism, is the only solution to the minority problem. I have absolute faith in the potential of black people to compete in this society. When I first came to Rochester, the social climate was oppressive and hostile; I had a great deal of difficulty finding a place to live. Today, there is improvement in Rochester. . . . Kodak is not perfect, but from where I sit, Kodak is able to recognize what the real problem is, and do something about it. And the real problem is that you can't bring about fundamental change and develop a sense of personal worth, without education and training." Dr. Knox studied at Harvard and received his M.A. and Ph.D. at M.I.T.

Butler King Couper, Course XV, of Washington, D.C., is presently connected with the Naval Ship Systems Command as an oceanographer. In his report, he states that after he left M.I.T. in June, 1929, he took a trip around the world before he became a textile apprentice. Caught up in the Depression, he had various odd jobs until 1933 when he started to work as a rate engineer for South Carolina Power Co., in Charleston, N.C.

When World War II began, King Couper enlisted in the U.S. Navy, took an officer training course in oceanography at Woods Hole and finished his military duties with a rank of Commander USNR (Retired). In 1948 he entered Scripps Institution of Oceanography (University of California) to further his studies and received his master's degree in physical oceanography. He was employed by the U.S.N., first at the Hydrographic Office, then at the Bureau of Ships as program manager for Naval Ship Systems Command's Ocean Science.

E. Neal Wells, Course VI, of New Jersey, who also attended the 40th reunion with his wife Helen, is presently assistant engineering manager-toll planning—American Tel & Tel General Offices and retired from army reserve as colonel in 1963. He states, "Recent participation in intercontinental telephony has extended my business travels to Europe and South and Central America. Son and his family live in Phoenix, so the distance is a handicap." His hobbies are photography and pistol shooting.

Hunter Rouse, Course 1-3, of Iowa City, Iowa, also attended the 40th reunion with his wife, Doi. Hunter has had a brilliant academic career. He is Dean of the College of Engineering, University of Iowa. He writes in his biographical notes, "1929-31 in Germany on M.I.T. fellowship. Taught at M.I.T. and Caltech until going to Iowa in 1939. Directed Iowan Institute of Hydraulic Research till drafted as dean in 1966. Authored or co-authored six books of which one or another translated into French, Spanish, Russian and Chinese. Lived in France during 1952-53 as a Fulbrighter; during 1958-59 in Germany, Italy, France and England on N.S.F. fellowship. Have traveled and lectured in every continent except Antarctica. Prefer Bora Bora. Doi and I thrive on the quiet life." Hunter met his wife in Germany while on an M.I.T. fellowship. The Hunters have three children and four grandchildren. As you might expect, his hobbies are travel and photography.

The **Wally Gales** had two VIP's as weekend guests in their Melvin Village, N.H. home, families of President Howard Johnson and Frank Mead, our Class President. Among other winter sports, the men had an ice-fishing expedition on Lake Winnipesaukee, but returned empty-handed. The fish would not bite.

Just a reminder: Those wishing to attend the Tech Night Pops Concert at Symphony Hall please send your reservations to me for choice tables. With best wishes—**Karnig S. Dinjian,** Secretary, 32 Oldham Rd., Arlington, Mass. 02174

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By the time these notes reach you the 40th reunion will be close upon us. As of this writing the reservations are still coming in at a respectable rate. In addition to those listed in the April notes, the following have indicated that they will attend: Cooper, Crowell, Henrietta Dane, De Lorenzo, Fred Dickerman, Dow, Fenton, Gonzalez, Houston, Lawson, Lytle, Peters, Plant, Riley, Rypinski, Spaans, Tarr, Wadsworth and Wilson. If you haven't already signed up, now is the time.

The January 28, 1970 issue of the *Boston Globe* reported that the previous evening more than 200 people had witnessed the presentation by Brandeis University to **Sidney Kaye** of a medal for distinguished service to higher education. In his acceptance speech Sidney said: "The greatest honor you can show me is the manner in which you are willing to help this proud institution so dear to me. . . ." Responding to this plea, Norman Rabb, a director of Stop & Shop and former chairman of the board of trustees, announced that $175,000 had been subscribed to a Sidney L. Kaye Scholarship Fund. It was further reported that over the years Sidney had contributed some $50,000 toward a scholarship in memory of his parents and grandparents. As previously recorded in the notes, Sidney is president of Suffolk Grocery, Inc.

Norwood Kenney retired about a year ago as engineering vice president of Simplex Wire and Cable Co. but continued until recently to act as a consultant to Simplex. He is a Fellow of I.E.E.E., a member of C.I.G.R.E. (international conference on large high tension electric systems), holds several patents and has written numerous technical articles. The Kenneys have four sons, three of whom are married, and one granddaughter. As of the date of his communication, he was employed full time on the construction of a doll house for his granddaughter. . . . **Joe Rehler** retired on January 31 as a Captain, Civil Engineer Corps, U.S.N. For three-and-a-half years prior to his retirement he was with Hq., U.S. European Command in Paris and Stuttgart as Chief, Civil Engineering Division, during which period he traveled extensively on the continent and to London. At the time he

wrote, he was enjoying a post-retirement vacation in Nerja, Spain, but plans to return in April to the U.S. where he hopes to be able to make a contribution to the anti-pollution program. He says, "as a diplomat in the American Academy of Environmental Engineers, I have considerable interest in that program." The Rehlers have a married daughter JoAnn and a granddaughter.

Bill Waite is with duPont's engineering department. For the last 39 years he has been "building petroleum refineries and chemical plants in my own way, that is, with an absolute minimum of supervision and other irksome forms of management." He reports: "With a little arm-twisting I will modestly admit to being the world's best fresh water fisherman, my specialties being land-locked salmon and brook trout. My range is limited to Maine and Vermont, by choice. I have been known to go down deep and get a record-breaking lake trout. I have climbed Mt. Katahdin twice, once in 1930 when Charlie Cooper guided a party of us which included Bill Ryan and Doc Lewis. The second time was in 1968 when I went right straight up Abol Slide, and then required a whole week to get my legs back. Like as not, I will spend more time on genealogy and less on mountain climbing." Bill holds very strong views on the recent student confrontation at M.I.T. The Waites live in Wilmington and have two sons and two daughters, all married, and six grandchildren.

Supplementing the note last month about **Graham Walton**'s retirement, early in January he presented a paper, "Developments in Water Clarification in the U.S.A.," at a symposium on "Water Treatment in the '70s" sponsored by the British Society for the Examination and Treatment of Water and the British Water Research Association at the University of Reading in Reading, England. After the symposium he visited waterworks and health department personnel in England, Netherlands, Germany and France to determine procedures used in Europe to assure protection of the quality of water within the distribution system. Graham plans to continue living in Cincinnati and do a limited amount of consulting work. The Waltons' son Robert is registered as a graduate student at Princeton, but is working on his Ph.D. as a visiting student at Harvard. He also works part time in computer science in the Harvard psychology department.—**Gordon K. Lister,** Secretary, 530 Fifth Ave., New York, N.Y. 10036

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John A. Hagen, Course I, after 15 years in his own business of manufacturing plastic toys is now an industrial engineer with the Naval Ordnance Facilities Laboratory in Silver Springs, Md. His son is a registrar and appraiser of wills in the U.S. Courthouse. . . . **Robert R. Anderson, Jr.,** Course VI-A, has been a patent attorney with the Navy Department in Washington, D.C. for 27 years. He and his wife visited Cambridge this past summer. A daughter is a teacher of music in college.

F. Carlyle Roberts, Jr., Course XI, has been in public health activities for 28 years. He is now a captain in the U.S. Public Health Service and is a sanitary engineer at St. Elizabeth's Hospital in Washington, D.C. His wife passed on two years ago. At Christmas he visited a son and brother in California. Carlyle recently qualified for a pilot's license and bought a four-passenger Piper aircraft. . . . **Dwight S. Ashley,** Course II, is engaged in computer development at the National Security Agency at Ft. Meade, Md., commuting from his home in Alexandria, Va. He and his wife play bridge and golf for relaxation.

After 37 years in government service, **John W.** (Nick) **Flatley,** Course XVII, retired in November as assistant commissioner for transportation and utilities in the General Services Administration. In World War II he was engaged in Lend-Lease activities. Last summer he and his wife visited Naples, Italy and they are currently planning a trip around the U.S. to visit 21 nephews and nieces.

William Liben, Course VIII, is in optics research with the Navy Applied Physics Lab and assists NASA on some projects. William deplores the lack of respect students show at M.I.T. and considers that too much restraint is used by M.I.T. in counteraction. . . . **Joseph B. Paul,** Course XV, has owned an Oldsmobile dealership in Washington, D.C. for 35 years. He plays golf on and off vacation and has two grandchildren.

Ralph W. Crary, Course X-A, although ostensibly retired, keeps his hand in as a consultant on industrial research matters in Bethesda, Md. Ralph is active in civic work and has been president of the Citizens Association of Montgomery County. He has succeeded in making the school board autonomous of political control. He has three children and one grandchild. . . . **Captain John W. King, 3rd,** U.S. Navy-Retired, is a stock broker with Burton, Dana and Westerlund, Inc., in Alexandria, Va. He was formerly an executive with Power Generators of Trenton, N.J., where he is still chairman of the board. He has a son who is a navy captain and his oldest daughter is a student at Holyoke. There is also a grandson, John W., 5th, naturally. . . . **F. Rolf Morral,** Course XIV, contributed a paper, "Cobalt Base Alloys in Aerospace" to the program of the Society of Aerospace Material and Process Engineers at its first national technical conference in September 1969.

Rolf Eliassen, Course I, is referred to in January 3 *Business Week* as "the professor with the answers to pollution." You recall that Rolf has been teaching a course in "Man and his Environment" at Stanford University since 1961 and has served on many government advisory committees. A recent appointment was to the panel of consultants to advise the Committee on Public Works, chaired by Senator Jennings Randolph.

Du Pont is also a place where pollution abatement is of major importance and **Joseph L. Richmond,** Course V, who is works manager at Chambers Works, in Deepwater, N.J., stresses that pollution control is a line responsibility of plant management. . . . **Glenn Poorman,** Course X-A, has retired as president and chairman of the executive committee of Esso International. Glenn began his career with Standard Oil after receiving his master's degree in chemical engineering with our Class following his graduation from Dartmouth in 1930.—**Elwood W. Schafer,** Secretary, Room 13-2145, M.I.T., Cambridge, Mass. 02139; **James Harper,** Assistant Secretary, 2700 South Grant St., Arlington, Va. 22202

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We open this time with a note from Armand L. Bruneau, Secretary of the Class of 1938. He is also a member of the M.I.T. Alumni Day Committee, and specifically he is promoting the Pops, Arthur Fiedler, the tables in Symphony Hall et al. Armand suggests that we, 1933, reserve a table far in advance, for the Sunday night Pops Concert, June 14, 1970. Those of you who hope to attend this concert as part of Alumni Day high jinks, we suggest that you get in touch with your President, Jim Turner, 5 Downing St., East Greenwich, R.I. 02812. I am writing to Jim at once, so that he will be prepared for any great onrush of applications. It is unfortunate that word gets to us so late.

We have an unusual clip here about a family named Morse. The clip is from the *Dartmouth Alumni Magazine,* and the Secretary of the Class of '02 says that he has heard from K. L. (Kid) Morse, who, among other things, has a son who was not wanted by Dartmouth, so went to M.I.T., and the University of Munich, and is now a distinguished member of the M.I.T. Faculty. This fella is our one and only **Dick Morse,** of course, and, just for the record, Dick has a son who is also an alumnus of M.I.T. (1968). Have I ever said that Dick appears to be irrepressible? To think that Dick almost went to Dartmouth; perish forbid!

I have a note from Vice President **Cal Mohr,** who mentions the always ingenuous and newsy Christmas card from Lucy and **George Henning.** Right Cal, it is an outstanding card; one to which we look forward each year. And many sincere thanks to them for remembering us. Further, Cal reports at some length on an ex-classmate, John Streng, who it seems, graduated with a later class. Anyway, John was a good friend and we hate to lose track of him. **Harry Summer,** the ingrate, writes to Cal about this and other things, but not to me, and just when I need it, too. Harry's older son is a junior majoring in journalism at

the University of Illinois at Urbana, and the younger son intends to go either to Yale or Michigan after he leaves Evanston High. Cal also bemoans not getting a card from **Charlie Thumm,** after having gotten 30-odd successive cards from same.

We have a handwritten note from Vice President **William Harper,** Texas, but most of it is unquotable, as it is personal. He did, however, attend a convention of his profession at the Fountainbleu, Miami, in January, and he was cold (30 degrees, it says here). Serves him right; he didn't phone me, and he knows I was only 40 small miles away. He even blames Florida for his getting the flu while here. William has a legitimate gripe, as Vice President. He announces that our 40th Reunion Fund drive seems to have stalled. I must agree, as I too, hear nothing, but I, unlike William, am not on the committee, ex-officio, or otherwise. Thanks, Bill, for your note. I suggest that you stay away from Miami until August when you will feel more at home.

Perhaps they do not belong here, but I have Eddie (Ted) Davis' "Greetings for 1970"; a poem of 20 stanzas, with 8 lines of verse each, complete with Eddie's philosophy. Eddie is one of our oldest, Class of 1901, so there. Anyone in our Class or 1901 who would like a copy of Eddie's poetry, please ask and I will Xerox the thing and mail it. Don't forget, the man is out of M.I.T. almost 69 years.

We had a fine letter from **Bill Brothwell,** in which he acknowledges a card, then proceeds. He got into an auto accident and hurt his back real much; so much so that he is taking osteopathic treatments for a rather bad back caused by the whiplash when hit. Musta been from the back! To explain his rather hard-to-read handwriting, he says that he is writing while lying on his back. Golly, maybe that's the way all these poor writers do it. Bill says that this life is a rat race, and he is on the point of getting out of sales and into a 9-to-5 job, at a salary. Haw! Don't do it, Bill; I tried that for 15 years, and gave up on it. That is sometimes tedious, also. Bill's 90-year-old mother is still active; she gets the meals, handles all phone calls when Bill is away, and is generally useful. Fellas, ponder this one, 90 years and still active, and happy. Well, we can hope, no? Sure, Bill's handwriting was hard to read, but he did write, which is more than the other 800 did. Many thanks, Bill, and your classmates will be pleased to hear about you.

From Wilmington, Del., comes a fine letter (a reply) from **Bill Conant,** and this reply came at a most opportune time (not too much material for the news). Golf is Bill Conant's favorite hobby, but bridge also gets into the picture. He gets to Boston quite often to see his sisters' families, but he does not say whether or not he visits Cambridge. As an aside, badminton and tennis are too active at his age, sezzee. Daughter Marsha graduated from Ohio State University a year ago, Summa Cum Laude, Phi Beta Kappa, et al, in psychology, and is now a guidance counsellor for five elementary schools in Dayton, Ohio. Her husband has just received his masters from O.S.U., and he is heading towards his doctorate at Duke where he took his bachelors with a major none other than physical chemistry. Gosh, fellas, y'all remember Professor Millard, he of the golden voice? We enjoyed his voice so much as to neglect to hear what he was saying. Son Roger graduated from the University of Delaware two years ago, and went into the army at once. Bill says that Roger's strong point at college was anything but studies, being very active in athletics. So, when he went to Vietnam, he finally found himself on the general's staff, and, the general happened to like Roger's brand of tennis, so that when he got back from the wars, he found himself to be the only tennis player who came back with a stronger forehand than when he left. Bill, all of your old and true friends will appreciate hearing from and about you. You have our sincere thanks.

Recently, I spent the better part of a week in Denver, attending the National Western Livestock Show. The sight of almost 100 carloads of twenty bulls each is awesome. All breeds of beef are shown and it takes most of the week. One person may not see all the events, as the rodeo and horse shows are run concurrently with the cattle showing.

While in Denver, I phoned a few classmates and found none of them home, but their lovelies were, and though I did not get to make a personal call, I did talk at great length with the girls. They were obviously glad to hear from M.I.T. and of the Class through me. I talked first with Doris, good wife of **Gene Cary** Course XV, management (like Jim Turner et al). Many of you must know that Gene suffered a crippling disease about 15 years ago, and is almost totally incapacitated, and to receive the kind of care he needs, he stays in a neighborhood nursing home, in Aurora, Colo., his hometown. Those who knew Gene might well take a few minutes and drop him a line at 540 Fulton St., Aurora, Colo. Gene is a native of that sovereign state.

The Carys have two sons; the elder son is 34, married, and this family has two stepchildren, and one daughter. He went to Colorado College and Colorado University and he lives, I recall, in Greeley, Colo. The younger son is also married, but has no children yet; he too went to Colorado College, and is now studying for his doctor's degree at Texas Southern University. Doris sees Gene sometimes twice each day, and she keeps fit by bowling, and sharp by playing bridge. She says that there is no time for more, obviously. Doris is a great person to talk with, and I do believe that we both enjoyed our phone visit. Doris, you are a great girl; thanks for your time, and such a nice visit.

I also phoned up the home of **Harris Thompson,** of Boulder, Colo. Again, no husband, but the lovely Lee talked it all over with me. Harris runs his own small business, a special medical equipment shop dealing, as I understand it, in portable, respiratory equipment. Harris finds it interesting and profitable. Both Thompsons are avid skiiers, and are interested in collecting pieces of Indian weaving. They are also interested in a national movement on foreign student advising which appears to have a good deal of merit. Both are workers, and enjoy these extra-curricular activities. And, both are native westerners. Again, and luckily, Lee seemed to enjoy talking it over with me, as of course, I did too. I sort of hope to establish mutual correspondence with these and many of the other girls, wives of classmates too busy to write Ye Secretary. Thanks a million, Lee, and do write if the spirit moves y'all.

The last phone call was to the home of **Fred Walker,** right in Denver. Again, the man of the house was out, but the lady of the house was in, and that was really all I needed. Frances is the name of this lovely. It seems that Fred had suffered a mild heart attack earlier but appeared to be able to go back to work. Fred has been with the U.S. Bureau of Reclamation almost since commencement. The bureau is a part of the Department of the Interior. The last I heard, Fred was working at flood prevention and on the measures, as I understand it elsewhere, which precede dam construction, and other flood control specifics. However, Fred will not go back to field work for some time, as his health appears to be more important. The Walkers have one daughter, a graduate of the University of Colorado, now married and living in Massachusetts. This daughter has two children, which gets Fred into the Club. Fred's hobbies are woodcarving, and pen and ink sketching. Frances was quite cooperative, as most 1933 wives are. Frances, I appreciate our little talk and do hope that we can compare notes a year from now. Thanks a whole great big lot.

On United, N.Y.C. to Denver, I carried a copy of *Coronet,* mostly to hold while sleeping, and in an article on waste disposal (garbage and rubbish et al), I found our own **Athelstan Spilhaus** quoted in a rather sage manner; Athel said, apparently, that we might well solve the junk automobile problem by selecting a few accessible, but remote spots, throw the auto body material onto the pile, and let nature take its course. The idea seems to be that sooner or later, probably later, we could mine the stuff. So, Athel sure ought to get honorable mention for that one.

And now comes a fine message from Veronica, **Joe Dysart**'s lovely. Golly, I am getting quite a few gals lined up, pinch hitting for the old man. Veronica says that I might never hear from Joe, but that she couldn't resist my pitch. Gee, I guess it was, at that. Joe

is vice president in charge of DC-8 and DC-9 programs and product support, of McDonnell-Douglas Corporation, Long Beach, Calif. The Dysarts have three sons, to wit: Christopher, a graduate of the Air Force Academy who is now flying FA Phaetons in Vietnam; Barry, a graduate of the University of Santa Clara who is at present in training as a U.S. Navy pilot, at Pensacola, Fla.; and Jeffrey, a pre-medical student at Santa Clara. Now I know why Veronica came through! She says that she keeps in touch with any and all, and also keeps busy in community affairs. So, V, many, many thanks, and best to Joe, if he will stand still long enough to listen.

We have a few address changes for your approval; William R. Appeldoorn, ME(II); Dr. Edwin R. Gilliland, CH(X); Ernst W. Spannhake, ME(II); R. Barlow Smith, CH(X). These address changes are available to any and all qualified classmates who write to ask for them—the letter to be accompanied by a short, terse, legible biographical sketch of self, family. This winds up the May offering, short as it is. As any and all may see, you chaps can carry your modesty too far, and so get short class notes. Best to all.—**Warren J. Henderson,** Fort Rock Farm, Drawer H, Exeter, N.H. 03833

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By the mid-March deadline on copy for this issue of the *Review,* 30 couples had already signified their intention of attending the 35th reunion by registering. Approximately a dozen additional classmates indicated they planned to attend, but had not yet sent in their registrations. A few who have been regular attendees have actual or possible conflicts as to time. Those registered who are new to reunions include Wes Loomis, Jack Orchard, Goffe Benson, Bob Kennedy, Bob Flood and Jeff Farmer. Among the regular attendees who were at the 20th, 25th and 30th were Randy Antonsen, Allan Mowatt, Leo Beckwith, Bill Abramowitz, Nix Dangel, Howard Beck, Bissell Alderman, Irving Banquer, Bob Forster, Jerry Golden, Pete Grant, Rufus Applegarth, John Taplin, Art Marquardt, and Ellis Flink. There are a few with conflicts, such as weddings and graduations. Even as you read this, it is not too late to join up.

Chuck Debes runs a consulting engineering business in Rockford, Ill., and also a retirement home. He had to build the retirement home himself, as some doctors who had said they would put up the money backed out and he took over. He says that it is now a most successful operation and that he is about to build another one.

Wesley H. Loomis, 3rd, is president of the Episcopal Charities for the Diocese of Chicago. . . . **Richard F. Jarrell,** formerly president and chairman of the board of Jarrell-Ash before the 1968 merger with Fisher Scientific Company, will handle market planning and technical consulting for Fisher. Jarrell-Ash pioneered in the development of spectroscopic instruments. . . . **George M. Reece,** formerly an associate, has been elected a director of the corporation by Fay, Spofford and Thorndike, engineering consultants in Boston.

Forrest J. Goldsmith reports that he has been working for the past 15 years at BTU Engineering Company in Waltham for **Howard Beck,** also Class of '35. His second of four daughters, Ellen Goldsmith Switzkes is a graduate student at M.I.T. in her second year and working towards a doctorate in chemistry. . . . In the January Interim Report of the M.I.T. Alumni Fund, the Class of 1923 edged 1935 out of first place in dollars actually donated.—Co-Secretaries: **Phoenix N. Dangel,** 329 Park Street, West Roxbury, Mass. 02132; **Irving S. Banquer,** 20 Gordon Rd., Waban, Mass. 02168

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Nobel Laureate **Robert B. Woodward** was invested as an Honorary Fellow at the Weizmann Institute of Science at ceremonies marking the 25th anniversary of the Institute. . . . **Randal M. Robertson** became the third person to receive the Distinguished Service Award, the highest honor of the National Science Foundation. He has retired as deputy assistant director for research at N.S.F. after 24 years in federal service. . . . **Harold V. Nutt,** technical director of the Naval Ship Research and Development Laboratory, recently received recognition for his thirty years of government service. . . . **Brockway McMillan** appeared in print last fall with a paper in the *Bell System Technical Journal* on "Communication Systems Which Minimize Coding Noise." He is currently vice president of military development at Bell Telephone Laboratories, and is in charge of the North Carolina Laboratories, Defense Systems, the Field Operations and Support Division, and the Safeguard Design Division.

Robert Gillette, chairman of the board of National Life Insurance Company of Vermont, has been reelected a director of National Life Investment Management, Inc., a subsidiary of the insurance firm formed to serve as investment adviser to the company-organized mutual funds, Sentinel Growth Fund, Inc. and Sentinel Income Fund, Inc. . . . **Edward Dashefsky,** senior vice president of Raytheon Co., was elected director of Visual Electronics Corp. . . . As manager of engineering for Global Marine, Inc., **John R. Graham** is responsible for all design work on Global Marine ships as well as for the company's drilling and marine equipment.

Along with his contribution to the Alumni Fund came an announcement by **Hamilton Migel** of his impending retirement from Magnaflux Corporation. The Migels will make their permanent residence in Charlestown, R.I., where they have had a summer home for many years.

In case you have any news, you can reach your secretary at her "summer" home turned permanent.—**Alice H. Kimball,** Secretary, P.O. Box 31, West Hartland, Conn. 06091

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Fellow members of the Class of 1938—to the breach. For the first time since I have been writing class notes, there is almost no news and that is because you and you and you have forgotten to write in. We do accept all of this unpaid advertising and I think you will agree that the price is right. So if you want the publicity, for goodness sakes, write me.

Nathaniel M. Martin, according to a news release, has been named vice president of ITT's Sheraton Corporation of America and has also been named president of Sheraton Design and Development, Inc., a subsidiary providing technical services in design, decorating and engineering. . . . **Bruce Old** has been appointed the first foreign secretary of the National Academy of Engineering. Bruce is currently senior vice president of Arthur D. Little, Inc., in Cambridge.

If you haven't already gotten around to it, get in your reservation for Alumni Day. At the risk of being boring, the Class of 1938 will have X tables at the Boston Pops, where you will have the opportunity of renewing old friendships and drinking some of that horrible wine punch which is dispensed while Arthur Fiedler swings his baton.—**A. L. Bruneau, Jr.,** Secretary, Hurdman and Cranstoun, Penney & Co., 140 Broadway, New York, N.Y. 10005

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John M. Gray, Class of 1910, architecture, wrote a sad letter that his son **John M. Gray, Jr.,** also from Course IV, passed away on February 1, 1970. John and his father conducted an architectural firm in Boston, the John M. Gray Co., Registered Architects. John, as a junior partner, was a member of the American Institute of Architects, the Boston Society of Architects, and a registered architect in the States of Massachusetts, Maine, and Rhode Island. He held a National Council of Architectural Registration Boards Certificate. For 20 years he had served as chairman of the City of Salem Planning Board. During World War II he served as chief engineer for the Department of Public Works of the U.S. Navy.

A brief note from the Alumni Records Office indicated that **Peter K. Jungbluth,** Course X, died on January 19, 1964. His address had been: 1126 South Iowa Avenue, Washington, Iowa, 52353. No further details were given.

David E. Morgan, Course III, sent an informative letter about himself. "I am president of my own company in Pawtucket, R.I., the Peerless Precision Products Co., manufactruers of components of jet engines and propellers. I have re-

cently acquired and become president of a special metal improvement and metal finishing plant in Attleboro, Mass., Aero Technology Corp. We are working on improvement of special finishing processing of titanium metals to be greatly used in the new F14, F15, and SST planes. The balance of my time is spent with the engineering and manufacturing sections of American Steel and Pump Co., of which I am the senior vice president. Our plants are located in Texas, Oklahoma, and New Jersey. In between, I give time to charity work for the Exodus House in New York of which I recently became a director. My four children, 9 to 15, are doing very well in school and while they are getting older, I am getting younger!"

Clifford Frondel, Course XII, Professor of Mineralogy at Harvard, headed a four-man team of geologists who studied a lunar sample brought back by Neil Armstrong. He was one of four scientists who made the preliminary lunar-sample analysis at N.A.S.A. headquarters in Houston during the summer of 1969, and then continued with detailed studies in the fall, back in his Harvard lab. An excellent review of Professor Frondel and his work appeared in the *Harvard Alumni Bulletin* of October 6, 1969, including a delightful photo taken at a microscope. This photo substantiates the *Bulletin*'s description of Professor Frondel as "shortish, chin-whiskered, and ebullient."

The *Wall Street Journal* reports that **George F. Schlaudecker,** Course X, General Manager of the chemicals division of Sherwin-Williams Company, was elected vice president, chemical operations. And from the Old Colony Memorial, Plymouth Mass., we learned that **William S. Brewster,** Course II, was elected last year to the board of directors of the International Paper Company.—**Oswald Stewart,** Secretary, 3395 Green Meadow Circle, Bethlehem, Pa. 18017

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It is with regret that I must report the passing on October 5, 1969, of **Harry Bush** (whom many of you may recall as Harry Bushloff, XVII). I am indebted to Alan Katzenstein, '42, who made some kind, but undeserved comments on this column. Alan writes: "It has been a long time (almost 30 years!) since Tech days and our acquaintanceship there. (I was Class of '42.) But *you* can hardly be out of mind with your excellent performance as class Secretary and the regular column in *Tech Review.* For that, my congratulations. This letter is prompted by the unhappy need to communicate and record the passing of one of your Class—Harry R. Bush, Course XVII. Harry passed away last October 5th at the Palo Alto Veterans Administration Hospital after a long illness.

"Our friendship with the Bushes began about 14 years ago when we found ourselves neighbors in New Rochelle (207 Drake Ave., near Pelham Rd. or the Old Shore Rd. for an old New Rochellean like you), after they had returned from a tour of duty in Alaska. They had a little over a year at First Army HQ, Governors' Island, then assignment in Tripoli, where Harry was port commander and received an Air Force Commendation Medal for his support of our Wheelus Air Force Base there. At the start of his illness, Harry was transferred back to Washington, for duty in the office of the chief of transportation, so that he could be near the best medical help the army could provide. He was given medical retirement in 1964.

"Although Harry was not in close touch with Tech classmates, he was proud of his M.I.T. background and numbered several alumni among his good friends. He was one of the many who left science and engineering but credited the Institute for its superior preparation. Marsha (Mrs. Harry R.) Bush is living at 580 Arastradero Rd., Palo Alto, Calif. 94306. I trust all goes well with you, Al, and that you will continue with your great job of reporting news of your class."

I have also just learned of the death of Dr. **James S. Brierley** on April 19, 1968, but have no further information.

Bill Bulkley, Course X, has been promoted to senior research associate at the Whiting, Indiana laboratories of American Oil Co. Bill has been with the Whiting group since 1947 and has specialized in research on safety and in the design and development of techniques and devices to improve refinery operations. He also has been studying pollution control and problems related to air and water conservation. Problems all of us are concerned with these days! Bill and Mrs. Bulkley reside at 8 Beverly Place, Munster, Ind.

I. M. Pei gave a series of five essays about his work and concepts of architecture on TV Channel 2 (Boston) the week of February 2-6, 1970. Each film concentrated on a different aspect of his work. Pei's goal was to show how he creates functional and beautiful architecture for today's cities. . . . **Edward Josephson** who is associate director for food irradiation at the U.S. Army Natick Laboratories spoke to the Connecticut Valley Chapter, American Society of Agricultural Engineers on "Food Irradiation."

Jim Baird, Course X, was appointed assistant general manager of the duPont pigments department. He has been director of sales for the pigments department since May, 1968. He joined the company in 1940 as a research chemist at the Newark, N.J., pigments plant. In 1942, he became a shift supervisor at the Wabash River Ordnance plant built and operated by duPont for the Government during World War II. Jim entered the army in 1943 and served in the European Theater. In 1946, he returned to the pigments department as a research chemist. Moving into production, he was successively an area supervisor at the Newark and Newport plants. In 1953, he became production supervisor, working with titanium and silicon. Five years later, Jim was promoted to assistant plant manager of the Baltimore plant. In 1959, he became assistant sales manager for white pigments and the following year was promoted to sales manager for pigments. He became a production manager in 1963 and then was director of production before becoming director of sales. Jim received an honorary degree of Doctor of Science from Ursinus in 1968, and has been chairman of regional fund raising campaigns for the college. He is a member and former chairman of the board of trustees of Westminster Presbyterian Church and has also served as chairman of the Annual Giving Committee for Friends School near Wilmington.

Joshua Feldman, Executive Officer of the Draper Laboratory, is a member of a committee appointed by President Johnson to study the future course of the Draper Laboratory and its relationship to the Institute. There are no easy answers to the serious problems involved in what is to become of the Draper Laboratory.

From **Ed Kingsbury,** a short note: "Last May I became an account executive with E. F. Hutton and Company. Very enjoyable and it might even be rewarding if the stock market ever goes up." . . . See you at the reunion, wherever it is!—**Alvin Guttag,** Secretary, Cushman, Darby & Cushman, 730-15th St. N.W., Washington, D.C. 20005

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James A. Creighton, Jr. has been promoted to the position of general manager of Bethlehem Steel Corporation's Burns Harbor, Ind., plant where he had been assistant general manager since March 1967. Jim's association with Bethlehem began during the summers of 1937, 1939 and 1940 when, while a student at M.I.T., he worked at the corporation's Lackawanna, N.Y., plant. His permanent career with Bethlehem dates from 1945, when he was named a special trainee engineer at Lackawanna. Three years later he was appointed process engineer in the plant's sheet mill. In 1950 he moved up to general process foreman in the cold-rolled sheet mill, and was named superintendent of the sheet mill division in 1960. A native of Harrisburg, Pa., Jim saw service with the U.S. Navy during World War II, enlisting as a seaman, and attained the rank of lieutenant commander before receiving his honorable discharge. He and his family reside at 15 Crest Drive, Dune Acres, Chesterton, Ind.

Edwin G. Kispert has been appointed general manager of the newly created industrial and marine department at the Babcock & Wilcox Company's power generation division headquarters in Barberton, Ohio. In his new position he will direct the marketing, engineering and manufacturing of B&W's line of industrial and marine boilers and related products. Ed joined B&W in 1946. After

experience in engineering sales and service in Chicago and New York, he was transferred in 1958 to Barberton where, in 1960, he became a section manager in the marketing department; and since 1962 he has been manager of proposition marketing. Ed is a native of Fall River, Mass., a registered professional engineer in New York, and the author of several technical papers dealing with boiler design. His wife, Margaret, died on January 19, 1970; he resides at 7563 Red Fox Trail, Hudson, Ohio, with his sons David, 22 and Peter, 19.

Robert Dawson Fletcher has been awarded the Charles Franklin Brooks Award for Outstanding Services to the American Meteorological Society. The award is named in honor of the founder and first secretary of the Society and reads: "for two decades of unremitting and devoted service to meteorology, and to the American Meteorological Society through his work on committees, as Councilor, and as President." It was presented at an honors luncheon held at the Washington Hilton Hotel last February during a joint symposium commemorating the Golden Anniversary of the American Meteorological Society and the U.S. Weather Services Centennial. Charles is presently director of scientific services, and of aerospace sciences, Air Weather Service, and is one of the Society's certified consulting meteorologists. He has served twice as councilor and was president of the Society 1956-57. Since then his service has included participation in committees on awards, nominations, Rossby Memorial Fund, chapters, and translations and abstracts. Born in Lampacitos, Mexico, he received a B.S. and two master's degrees, one in mechanical engineering and another in meteorology, from Cal. Tech. His doctorate was completed at M.I.T. His career has included airline meteorology; research and teaching at M.I.T., U.C.L.A., and Brown University; technical advisory work for the U.S. Air Force during World War II: and direction of the hydrometeorology section of the U.S. Weather Bureau. He pioneered in the field of weather radar, headed the staff that initiated operational numerical weather prediction, and laid much of the groundwork for operational use of weather satellite data.

Harry H. Wasserman has been elected a Fellow in the New York Academy of Sciences, according to the January 5, 1970 issue of *Chemical & Engineering News.* He is a professor in the Department of Chemistry at Yale University.

Anthony T. Shtogren, deputy director for communications/electronics for the Joint Chiefs of Staff, has been promoted from brigadier to major general. Also he has recently received the Air Force Distinguished Service Medal for his work as head of the Air Force communications organization. His Air Force career began in 1941, when he entered the Army Air Corps as a weather officer. He has served in various command positions including Omaha AFB, Westover AFB, Langley AFB, AWS Headquarters, and in the Pacific area.

Tirso G. Fajardo is now retired from his post of commanding general of the Philippine Army and lives on St. Thomas, U.S. Virgin Islands with his wife, Diane, who is associated with the Tropicana Perfume Shop there. He has one son presently in the air force and another, a second lieutenant who graduated from Ranger School in December and is now at Ft. Benning. Tirso is also a retired colonel of the U.S. Army since 1946.

Edith L. R. Corliss is working on a book, *The Physical Senses,* including sight, touch and hearing as a part-time effort for the National Institutes of Health. She is also still working as a physicist at the National Bureau of Standards in connection with human hearing, primarily on the perception of loudness. She reports that besides her husband, her household includes two boys "growing normally," one dog (brought home by the boys) and a fluctuating number of cats and kittens.

Howard J. Samuels has announced his candidacy for governor of New York. Also, according to an article in the *Democrat and Chronicle* newspaper of Rochester, N.Y., Howy admitted that his five oldest children have "experimented with marijuana" and said he hopes his experience "will alert other parents to the problem." His 17-year-old son, Howard, Jr., had been arrested in New York City for possession of hashish and methadrine. Howy said "Parents read stories about how prevalent it is—but they never think about their own children being involved."

Raymond B. Krieger, Jr. is the author of a publication titled: "Advances in the Corrosion Resistance of Bonded Structures." . . . **Robert L. Sinsheimer** is the author of an essay on the limits of the mind titled "The Brain of Pooh" which appeared in the January, 1970 issue of *Engineering and Science.* The essay cleverly uses lines from *Winnie-the-Pooh* to illustrate limitations in human perception of complexities about us. It points out the differences in human ability in such areas as language communication and locomotion due to evolutionary programming of the nervous system and the incomprehensibility of phenomena not in the immediate external world of human scale. Philosophizing, he states; "When we've mutated the genes and integrated the neurons and refined the biochemistry, our descendants will come to see us rather as we see Pooh: frail and slow in logic, weak in memory and pale in abstraction, but usually warm-hearted, generally compassionate, and on occasion possessed of innate common sense and uncommon perception." Robert has authored over 120 publications. In 1968 he was named California Scientist of the Year. His major interests are in properties and replication of nucleic acids, bacterial viruses, biological UV and IR spectroscopy. He received the 1969 gold medal for virology from the Royal Netherlands Academy of Science and Letters in Amsterdam last December. He is also president of the American Biophysical Society for 1970.—**Walter J. Kreske,** Secretary, 53 State St., Boston, Mass. 02109; **Everett R. Ackerson,** Assistant Secretary, 831 Cranford Ave., Westfield, N.J.; **Michael Driscoll,** Assistant Secretary, 63 Center St., Nantucket, Mass.

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More from **Pete Sloss** and a correction. He is with the Mercoid Corporation in Chicago, not Macoid as reported. Pete is quite busy with M.I.T. activities as second vice president of the M.I.T. Club of Chicago, working on the Educational Council and as a member of the Alumni Fund Regional Committee. . . . From the *Wall Street Journal,* **Pete Volanakis** who is president of Strathmore Paper Company was elected a vice president of its parent company, Hammermill Paper Company. . . . **Wallace Murray,** vice president of Grollier Inc., has been elected a director of the company. . . . **Charles H. Smith, Jr.,** has been promoted from president to chairman of Sifco Industries in Cleveland.

John W. McNall was promoted to the grade of Fellow by I.E.E.E. for contributions in microwave technology, and for direction of research and development in light sources. . . . **Robert C. Seamans, Jr.,** has also been promoted to the grade of Fellow by the I.E.E.E. for leadership in the application of electronics to guidance and control problems and for direction of space programs.

Cecil R. Gentry reported on the results of Operation Stormfury on Hurricane Debbie started last summer. Gentry is director of the National Hurricane Laboratory and has been working on hurricane control by means of silver iodide seeding. . . . Still in weather, environment and ecology, **Harlan K. Saylor** has received the American Meteorological Society's Award for Outstanding Service by a Weather Forecaster "in recognition of the extraordinary synoptic insight and forecasting skill which he has applied over many years to the effective blending of human judgment with machine calculation of the National Meteorological Center."

Fred Sargent, Dean of University of Wisconsin's College of Environmental Science spoke on the general topic of ecological adaptation at a joint celebration of the 50th Anniversary of the American Meteorological Society and of the 100th Anniversary of the U.S. Weather Service in Washington, D.C. in February. Fred also moderated a panel on managing urban environment at a conference sponsored jointly by the U.S. Committee for the International Biological Program and the Public Affairs Council.

William J. Knapp who received his Sc.D in ceramics with our Class was appointed assistant dean for undergraduate studies in the School of Engineering and Applied

Science at U.C.L.A. . . . The *Journal of Polymer Science* published an article by **Zigmond W. Wilchinsky** about X-ray measurement of orientation in the crystalline and amorphous phases of polyethylene.—**Ken Rosett,** Secretary, 191 Albemarle Rd., White Plains, N.Y. 10605

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Well, it's a reflection of the esteem and affection you '43ers hold for your class secretaries, we suppose. What? Why? Well, there were no loud complaints heard when we (I) missed the last issue! Sorry 'bout that. . . . I was travelling again in the Far East when it came my turn at the typewriter. Besides, who would DARE complain! This 2-man editorial staff always has "room" for one more man! With this introduction, don't be surprised if a tidbit about yourself looms here in print long after the actual event. After all, we never promised to print hot news! Sometimes we score a "first time since February 1943" receipt from a long silent brother. Now, you can't call that "hot" news. Anyway, hot or cold—or simply lukewarm—keep the items coming! We'll get to them eventually.

Late last year, a *Wall Street Journal* article was headlined "Torin Corporation Names Charles Hathaway As President." Our well-known classmate has moved up to take the top post of the re-named Torrington Manufacturing Co. of Torrington, Conn., makers of air circulating equipment. Charlie joined the firm in 1950 as the director of air moving laboratories and later became successively director of engineering and general manager of the Connecticut division. In 1967 he was made group vice president. Our well-known friend is active in many professional and community organizations. Charlie, with his wife and children, live in Simsbury, Conn. I wonder if those Connecticut executives know that the given-name of "Torin" goes back to a Gaelic chieftain of many centuries ago? Since there is a Torin Kelly here at home, it's hats off to the Men of Torin! And . . . good luck to the modern day chieftain, **Charlie Hathaway!**

Sidney Greenwald, President of Hart Engineering Co., made a few predictions earlier this year: "Industrial construction for 1970 should remain substantially the same as in 1969. Plant expansion may face minor adjustment because of the tight money market and high interest rates. . . ." Would you like to have another "crack" at these views you expressed in the *Boston Herald Traveler* in late January, Sid? I'd say the events have made you a good prophet, so far!

Gilbert M. Edelman has been appointed director of technology programs at Martin Marietta's Orlando, Fla., division. He will be responsible for advanced technology efforts in both in-house research programs and research in support of contractual R&D projects. Previously Mr. Edelman was corporate director of research and development programs for Kollsman Instrument Corp.

A late 1969 release tells us that **Jacob L. Yamins** has been appointed to the board of directors of Bio-Derivatives Corporation, Deer Park, N.Y. Bio-Derivatives is a manufacturer of fine quality amino acids and intermediates for the pharmaceutical industry. Recently, plans were announced to expand its facilities for the production of L-DOPA (levo-dihydroxphenylalanine), a promising new drug for treating Parkinson's disease. Dr. Yamins, manager of research and development, Pepsico, Inc. and a visiting professor at Rutgers University, food science department, holds a B.S. from Amherst College and an M.S. at Tech with our Class. From 1959 to 1967 he was director, science development, American Sugar Co. Previously, he was assistant to the president and coordinator of research for National Dairy Products Corporation.

An early January issue of *Industry Magazine* carried an announcement that **Charles F. Coles** is now vice president and director of marketing research at Pyrotector Inc., Hingham, Mass. The picture which accompanied the news squib shows that handsome face—still peering into the unknown future! Reminiscent of the starts of those 100-yard dashes in your undergrad days, eh Charlie?

John E. Guillotte of E. I. duPont de Nemours & Co. Inc., of Wilmington, Del., had a paper published in the *SPE Journal* in November, 1969, "Co-Extrusion of Blown Film Laminates." This contribution to the Society of Plastic Engineers needs no elaboration by me; if any reader would like my copy of the paper, please advise.

A recent release from Tinker Air Force Base in Oklahoma announced that **Gwynn H. Robinson** of Los Angeles "has been promoted to the rank of Major General in the U.S. Air Force Reserve." Gwynn was with our Class in Course XV until the call of the air force came in 1941; I've just re-read my copy of the "25th Reunion Biographical Sketches" which contains a complete rundown on Gwynn's accomplishments up to that point. The air force announcement mentions that Major General Robinson was recently cited for outstanding service to the United States by an award of the Legion of Merit. Gwynn is president of Diners Club International Ltd. He and his wife live in Beverly Hills, Calif.

Thanks to Bob Fay, '42, for sending a news clipping with the apt comment, "Thought someone would be interested in a success story!" The story from the *Cleveland Press* stated: "Professor **James Reswick,** renowned scientist and director of the Engineering Design Center at Case Western Reserve University, will leave to take a new post in California. Reswick will become a director of medical engineering at Ranchos Los Angeles Hospital in L.A." Jim, who got his B.S. in mechanical engineering with our Class (and later his M.S. and Sc.D. in the same field), is well known for his development of electronically operated artificial limbs and electrical devices which simulate nerve impulses. All this news goes back to November, 1969, when Jim was named winner of the 1969 Master Designer Award for outstanding contribution to the design engineering field. Jim is the founder of the Design Center at CWRU which developed a self-propelled wheel chair that can climb stairs and an artificial arm that is operated by the amputee assisted by photoelectric cells. About his new post at the county rehabilitation center in California, Jim said, "I'm particularly interested in the 4 million persons in the U.S. who have been the victims of stroke. Much can be done with electrical devices to help them regain use of their muscles." Jim also found time to head the Mayor Stokes Commission on Urban Transportation while living in Cleveland. Best wishes to you and your wife as you get established out West, Jim!

The "Notes on the Back of the Envelope" produced a small bonanza over the past several months. We reprint them herewith in manuscript form: **Loring F.** (Hos) **Hosley** writes: "Am well and happy. Enjoying life with my five children since we ski, fish, hunt and swim together. Business continues to grow and I only hope fellow alumni are as fortunate." Well, 'tis so, Hos—and how's about writing a longer passage next time and tell us about the "one that got away!"

John E. Ward tells us: "Was vice chairman for the Spring Joint Computer Conference in Boston, May 1969, and am on Program Committee for March 1970 I.E.E.E. International Convention in New York." Thanks, John, for the cryptic account but you'll have to send us the decoded version the next time. . . . What's I.E.E.E.?

S. J. Spitz, Jr., sends along a message that confirms the public press which covered the same event, "Have resigned from Tenneco to become president of International Flavors and Fragrances, Inc., effective January 1, 1970." That's sweet news from you, Jim! We hope the new paycheck adequately reflects the corporate title! . . . **Robert W. Beatty** wins the medal for brevity with this one, "I am alive and well in Boulder, Colorado." Thanks, Bob, and when next you come out to civilization, tell us more about yourself! . . . **Melvin Lax** writes, "Gave a series of three seminars at M.I.T. on fluctuations in classical and quantum systems with applications to lasers (January-March, 1969)." . . . **John C. Shackelford** tells us: "President of Potter-Shackelford Construction Co. since 1960. In November 1969 elected vice president of Associated General Contractors of America, Carolinas Branch. The Carolinas Branch includes members from over 2,000 firms." . . . **Bernard S. Liss** says: "I'm a senior

mechanical engineer with Star Parts Co." —**A. J. Kelly, Jr.,** Associate Secretary, 34 Scudder Rd., Westfield, N.J. 07090; **Richard M. Feingold,** Secretary, 266 Pearl St., Hartford, Conn. 06103

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Sorry for the hiatus in April—I was in the hospital under traction for a slipped disk but seem to have recovered without surgery, thank the Lord. This month I will try to put the news in alphabetical order since we go from A to V. But first, a commercial. It seems that our Class is lagging in Alumni Fund contributions (only 21 per cent as of the end of January). Please send in your checks to the Alumni Office so I can pay off the hospital bills (joke, of course).

Courtland Ames, is now director of planning for the Lone Star Cement Corp., in New York. Previously he had been director of marketing and that shows the versatility of M.I.T. men since he was a Course XVI (aeronautics) man. He and his wife, Doris, live in Darien. . . . Dr. **Richard Carter,** Course X, of the Chester Beatty Institute for Cancer Research, has been elected one of 51 Fellows by the New York Academy of Sciences. The Institute is in London, so I am baffled again.

E. M. Coan did send in his contribution because he wrote a note on the envelope. As might be expected for a Course VI man, he spent 2 years in Australia on communications satellite experiments. He had his wife and 5 children along to enjoy the assignment. Last year he was busy on the lunar module rendezvous radar and its preparations for the Apollo missions.

Another classmate overseas is **Warren B. Delano,** who is in Sao Paulo. The welfare of his seven-year-old made it advisable for the family to make Brazil their permanent residence. The boy speaks Portuguese like a native. Warren is working for one of the biggest and best engineering consultants in Brazil and is enjoying it thoroughly. His daughter, Norma, received her registered nurse's cap in December at the University of the Philippines, while his other son, Denny, is studying civil engineering.

We've got another classmate in the corporate planning business also. **Arthur F. Dershowitz,** chemistry, has a new job but he didn't state where. However, since he dislikes the commuting, I assume it is in the New York area. . . . The *A.I.A.A. Bulletin* for January 1970 announced that **Maxwell W. Hunter,** Course XVI, was to be a panel member discussing space transportation at a specialists meeting in Cocoa Beach, *Florida.* That's quite a concession for Max since he is director, Advanced Space Programs, Lockheed Missiles and Space Co., in Sunnyvale, *California.*

Walter A. Jaeger, Course II, was promoted to the new position of vice president-manufacturing services at the Emhart Corp. in Hartford. He joined Emhart in 1949 as plant engineer and worked his way up. Walt is a commissioner of the New Britain Board of Public Works, a member of the board of managers of the New Britain Institute and the buildings and grounds committee of the N.B. General Hospital. He is also a vestryman of St. Mark's Church and a member of the National Planning Association.

Raytheon in Lexington has announced that **Justin M. Margolskee,** Course II, has been named to the newly-created position of assistant general manager-operations for the Missile Systems Division. He is also a vice president and has served as manager of the division's Bedford Laboratories since 1963. Justin has been with the company since 1947 and is a registered professional engineer, member of IEEE, and American Ordnance Association. He and his wife, Helene, and four children live at 23 Peachtree Rd., Lexington. . . . Another new vice president is **Frank W. Nolan,** Course XIII. He was recently appointed to the position at the International Terminal Operating Co., a subsidiary of the Ogden Corp. Frank joined the company 23 years ago after leaving the Seabees and worked up to manager of engineering and purchasing. He is a member of several maritime societies and resides in Essex Falls, N.J.

The **Willis T. Pettey, Jr.** family is forging ahead in all directions. He is now vice president of the New Balance Athletic Shoe Co. in Watertown, Mass., and his wife, Betty, has recently earned her masters degree in guidance at Salem State College. She was already an R.N.

Edward P. Radford is "relevant." He is Professor of Environmental Medicine at Johns Hopkins School of Hygiene and Public Health in Baltimore. As he states, "These are challenging days in this new field, and I'm looking forward to interesting times." . . . *Optical Spectra* for September 1969 reports that **Sydney S. Sherby,** a retired navy captain, with a varied background in research and engineering, has been named vice president of Varo, Inc.

And now we get to the V's as I told you. **A. B. Van Rennes,** Course VI, has been appointed associate director-planning of the Bendix Research Laboratories in Southfield, Mich. He had been technical director of Bendix International in New York since 1966 and before that he was head of the nuclear technology group with a ten-year period as resident-director for European Scientific and Technical Liaison. . . . I do want to remind you that **Paul Heilman** is one of the Secretaries who keeps me informed so if you are in Westport, Conn., stop by to see him. Or drop a note to me at my home address listed below since I am now commuting to Annapolis, Md., and it is too complicated to explain how a Chicago-based research institute has an office in Md. with employees in Virginia. At least it makes interesting tax calculations.—**John G. Barmby,** Secretary, 924 Fairway Dr., NE, Vienna, Va. 22180

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Your Reunion Committee promises that it shall not be a white reunion similar to our New England white Easter. In fact, the long range weather forecasters indicate a fair, cool reunion weekend, June 12-15. As of April 1, Treasurer Bill Meade indicates 68 paid class dues with 120 needed for us to break even on our Class Book. A belated but necessary plea for funds.

You received the Reunion Committee's late March "All Hands" mailing over a month ago. We certainly hope you have been turned on! At the time of this last general mailing your committee had received some response from 140 class members. Reunion reservations can be made until the last moment. Should you have misplaced all the information forwarded just grab the phone and call me here in New York City. Collect calls accepted.

Tom McNamara reports that plans for the reunion continue to gain momentum. His report follows: "A recent addition to the schedule is that on Monday at 11:30 a.m. in the M.I.T. Chapel, the Reverend **C. J. Hooker** will conduct the Memorial Service for alumni who have passed away between June 1969 and June 1970.

"Over 140 reunion questionnaires have been returned for the reunion book and this looks like it will be a real bestseller. Remember that a copy of the book will be sent to each class member who has paid his $30 class dues. Bob Maglathlin reports that the response to requests for advertising has also been good so far and he hopes it continues.

"Arrangements for swimming, sailing, tennis and other activities for the youth program, and for those adults so inclined, also looks good. The main reunion souvenir has been selected; it will be a silver Paul Revere bowl representing an appropriate remembrance of the 25th anniversary and the Cambridge area.

"The reunion mailings are now going to over 160 Classmates who have indicated an interest in the reunion. If you are not receiving them and would like to, write to Gerry Quinnan c/o the M.I.T. Alumni Office. The list of those having indicated interest thus far is given below. Let's get your class dues in and also please forward your registration material as early as possible so that we can firm up our plans. T. J. McNamara."

Here is the list of '45ers who have expressed interest in the reunion:
Peter and Eva Agostin
Lloyd Balsam
Dick and Marge Battin
Curt and Wil Beck
George and Mrs. Berman
Bob and Mrs. Black
Bill and Judy Blitzer
Chris and Jean Boland
W. E. Borden
Al and Billie Bowen

Dr. R. Tully and Marley Bradford
Jim and Ellen Brayton
George and Mollie Brothers, Jr.
Chuck Buik
Julian and Louise Busby
Vince and Bobbie Butler
Bob Burton
Nelson and Edith Chang
Alvin and Debbie Cohen
Felix and Frieda Cohen
Dwight and Renie Collmus
Dewitt Cowan
John Cullinan
Emmett and Roxie Day
Frank and Alice Donahue
Sabino DiSavino
Samuel E. Duff, 2nd
Steve Eppner
Dan and Jan Flood
Jake and Kathy Freiberger
John and Carol Gaffney
Frank and Dee Gallagher
Jumper Gammon
John Geyer
Guy and Betty Gilleland
Howard and Marion Grant
A. Franklin Hahn, Jr.
Sam Haines
Al and Suna Hall
Matt Harrington
Charlie and Nancy Hart
Joseph and Eleanor Heschleba
Bud and Norma Hetrick
Tom and Betsy Hewson
Peter and Lou Hickey
Bob and Virginia Hildebrand
Jim and Mary Hoagland
Roger and Virginia Hood
Rev. Charles and Mary Hooker, Jr.
Clarence and Barbara Howell
Bill and Jayne Humphreys
Leo and Nancy Hoigne
H. W. and Helen Huston, Jr.
Bob and Barb Irvin
Robert and Dorothy Johnston
Don and Jeanne Kahn
George and Ruth Landon
George Laughton
Jim Levitan
D. J. and Margaret Lovell
R. Duncan Luce
Bob and Anne Maglathlin
Tom Markey
Andy and Anne Marocchi
Dick and Netta Martin
William and Jeane Martin, Jr.
Les McCracken
Ray McDowell
Bill and Betty McKay
Bob McKenna
George and Jan McKewen
Tom and Louise McNamara
William Meade
Warren Miller
Sam Moore, 3d
John and Louis Morrison
Bill and Betty Nicholson
Oakie and Lulu O'Connell
William and Fairlie Pasfield
Charlie and Janet Patterson
Jerome Patterson
Ray and Elaine Pelley
James Pickel
Gerry and Mary Quinnan
Robert and Myrna Roth
Ed and Val Reed
Joseph Reese
J. Rescher
Max and Trudy Ruehrmund

Class of 1945 Reunion Committee meeting. From left to right: T. McNamara, W. Meade, R. Maglathin, J. Pickel, C. Hart, C. Patterson, G. Quinnan.

Lee Schindell
A. R. Shelby
Bill and Elaine Shuman
Shaler Gordon Smith, Jr.
Clint Springer
J. Spencer and Elaine Standish
Tom and Jimmie Stephenson
Don Stevens
Ed and Elinor Stoltz, Jr.
(Maybe three kids)
Don and Betty Strang
J. J. and Edna Strnad
Paul Swartz
Fred and Janice Test
Dave and Mary Trageser
Bob Turner
George and Barbara Upton
Dan and Ruth Vershbow
Larry van Ingen
Ed Washburn
Al and Jeb Werner
Bud and Nina Wilson
Dick Winkler
James M. Barrabee
Dr. Frank D. Bates
George H. Bickford
Franklin B. Bossler
Robert S. Buxton
Marshall Byer
David B. Cohen
Robert S. Cox, Jr.
Ralph P. Cromer
Carlos A. Dasso
Raymond A. Dexter
John L. Dietche, Jr.
Thomas A. Doggett
Romeo R. Favreau
L. Robert Gardner
Ruth K. Hall
Robert W. Hallock
John B. Handrahan S. J.
Sheridan C. F. Ing
Hugh M. Jansen, Jr.
Miss Mary Ruth C. Jeffries
Daniel L. Jerman
Hartmann J. Kircher, 3d
Donald K. Kuehl
Claude M. A. Lebel
J. Jack Leonard
Sing Leong
William A. Loeb
Robert L. Lohman
Robert L. McMurtrie
Daniel G. Meckley, 3d
Alan G. Mencher
Harry W. Mergler
Robert C. Miller
David Mintzer
Nicholas V. S. Mumford. Jr.
Hedley V. Patterson
Luigi J. Russo
James W. Shearer
Isay Stemp
Waite H. Stephenson, Jr.
Stanley G. Timmerman, Jr.
Lloyd H. Turoff
John O. Von Hemert
Emily V. Wade
Jeptha H. Wade, 3d
Robert E. Welch
Robert L. Winter

Francesca and I spent a wonderful weekend in early March with the **Jerry Pattersons** in Binghamton, N.Y. Friday evening proved to be a black tie affair, the highlight of which was Jerry's performance in Verdi's *LaTraviata.* Now Jerry was neither Alfredo nor Giorgio but he certainly was an active member of the chorus. I lost count of Jerry's kissing the ladies' hands during Act I let alone his actions in Acts II, III and IV! Saturday was spent with Jerry and Lib's horse friends down in Dalton, Pa. The Pattersons are the proud owners of a couple of fine jumpers. Both Pattersons have asked that they be remembered to all their reunioning friends as they shall be attending Tony's graduation at Coe College that weekend.

Another disappointed non-attending family is the **Tom Stephensons**. Tom and Jimmie had planned a June trip to Cambridge; unfortunately Alcoa announced a change in plan in mid-February. As of March 1, Tom became works manager at Alcoa's Davenport, Iowa facility with the spring to be divided between Davenport, New Kensington, Pa. and management training at Princeton. Yes, moving day is Saturday, June 13. I am certain we will receive an en route phone call that Saturday evening. You both shall be missed.

Reunion Gift Chairman Max Ruehrmund, Jim Levitan, Chris Boland, Al Bowen and I spent Tuesday evening March 24, on another Reunion Gift Telethon. We must have made 70 calls to 70 wonderful guys and gals; we hope you all come through as indicated during the conversations.—Looking forward to seeing you in Cambridge next month.—**C. H. Springer,** Secretary, MFB Mutual Insurance Co., 420 Lexington Ave., New York, N.Y. 10017

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This issue catches us between ski trips and with a rather drastic shortage of news. Gina and I and the children spent a very enjoyable week at Mt. Tremblant and are leaving for a long weekend tomorrow for what we hope is spring skiing in Western New York State.

A letter from **John Williams** advises of the promotion of **Wally McGahan** to director of Research of Ingersoll-Rand. Wally received his B.S. in mechanical engineering with our class and returned to obtain his M.S. and doctorate—the latter in 1965. As I write these notes it is rather strange to realize that John, Wally and I were all in the same class and work for the same corporation but have really never met. I encountered Wally at a few meetings 15-20 years ago but never associated him as a classmate from school.

Henry Lee is keeping himself busy giving papers on Adhesive Restorative Materials to the dental industry. The past six months of 1970 find him in at least nine locations promoting the product for Expoxylite. Henry was a co-founder of this firm in 1954 and in 1970 was recipient of the Adhesives Award of A.S.T.M.

With these few words will leave hoping that the snow is not too sticky and looking forward to more mail next month. —**Dick O'Donnell,** Secretary, 28516 Lincoln Rd., Bay Village, Ohio 44140

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Stan Margolin asks me to announce that **Joe Schneider** has agreed to take charge of the Class of 1949 cocktail party in connection with the Alumni Day Weekend this June. Our best guess is that it will be held Sunday evening. Also scheduled for Sunday are the Alumni Dinner and an M.I.T. Alumni Evening at Boston Pops. Y'all come!

John W. Kunstadter announces the formation of Kunstadter Associates in New York City for "Consulting Services in the Application of Advanced Technology." Welcome to the consulting jungle, John, and good luck. . . . Laurence R. Hefter and **James E. Ryder** announce the formation of the firm of Ryder & Hefter in New York City, for the practice of law, specializing in patent and trademark matters.

Personal notes from the Alumni Fund envelopes—from **Harry De R. Gibbons,** informing us that he has changed positions and is now a vice president in charge of Midwest operations for Engineering-Science, Inc. . . . **Oscar F.** (Pete) **Noss** writes he is finding his assignment as superintendent of plants for Union Oil Company at Cut Bank very challenging and satisfying. The Noss family is thoroughly enjoying Montana, particularly because their third winter has been the mildest one of all, "appreciated by newcomers and old-timers alike."

Ernest Zapata Herrera reports he is the manufacturing vice president of Ecopetrol, the national oil company of Colombia, which is also the largest company in the country. His home is in Bogota; he and his wife, Margarita have one daughter, Marta Teresa.

Two notes close to home: **Russell N. Cox,** President of Linnell & Cox Inc., has been named a trustee of Continental Mortgage Investors (Boston), a real estate investment trust; and **William S. Edgerly,** Financial Vice President, has been elected to the board of directors of Cabot Corporations. Congratulations to both.

Since this copy will appear in May, it is pleasant to be able to look out my window as I write on the first day of spring and to observe the first spring-like day. Hope to see many of you at the cocktail party on Alumni Day Weekend. —**Frank T. Hulswit,** 77 Temple Rd., Concord, Mass. 01742

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Charles H. Carpenter is now with Bell and Howell Communications Co. in Waltham. He and Alida live in Belmont, Mass. . . . **John Conzett** reports from Chagrin Falls, Ohio that he is now systems marketing manager for Reliance Electric Co. He and Edith have two sons.

Joseph Gurland, Sc.D., Course III, was one of twenty-seven American scientists to be awarded the NATO Senior Foreign Fellowship in Science by the State Dept. and National Science Foundation. He will be studying at the University of Newcastle, Newcastle upon Tyne, England under the new program designed to foster interchange of scientific information among the NATO member nations. Joe's specialty at Brown University is engineered materials.

Promotions: **Jerry Elkind** has been promoted by Bolt Beranek and Newman to senior vice president. He will be heading the computer science, behavioral sciences, and computer systems divisions. **William Krivsky** has been elected vice president of General Cable Corp., New York City, maker of wire and cable products. Bill was formerly vice president of Continental Copper and Steel Inc. The Krivskys have four children ages eight to fifteen. . . . The air force has promoted **Clifford Kronaur** to major general. He is directing flight safety and collection of data on all missile launches from Vanderberg AFB. . . . **Charles Kurz** is now with the Brunswick Corp. in Muskegon, Mich. . . . **Joe LaQuanti** was selected by the air force to attend the Industrial College of the armed forces at Fort NcNair, Washington, D.C. He will be there until June, 1970.

Edward Lays is now in charge of the Mach 14-24 hotshot wind tunnel at Martin Marietta in Denver, Colo. I'm sure many of you will join me in being a bit envious of his hobby: flying his own Piper Comanche in those Colorado mountains.

Jack Monday writes from San Diego that he has left Cleveland where he was president of the American Vitrified Products Co., and executive vice president of the Amvit Corp. to become executive vice president of Intermark Investing Inc. in La Jolla, Calif. He is in charge of managing the subsidiaries, and with 17 new companies acquired within eight months, it sounds like he has his hands full. He is also active in the M.I.T. Educational Council work, and reports the family, Alyce and children Linda-16 and Scott-12 are really enjoying the California sun and surf. . . . A recent article in the *Astrophysical Journal* of Chicago was co-authored by **Hays Penfield,** Harvard College Observatory. The article describes the detection of a hitherto unobserved level of excitation of the OH molecule in space using the Algonquin Radio Observatory 150-foot dish antenna. The radiation is thought to be from a gigantic natural maser in the Milky Way galaxy energized by gas condensing under local gravity in the process of creating a new star.

Each year a number of our classmates actively participate in the Alumni Fund. This year Bob Cushman is chairman for Idaho Falls, John Dowds and Greg Gentleman are leading the campaign in Oklahoma City, Oklahoma and Des Moines, Iowa respectively; Adolph Hendrickson in Chevy Chase, Maryland; Bill Krampert in Park Ridge, Ill; Jim Pitcock in Memphis, Tenn; and Paul Smith in Caldwell, N.J. . . . **Fred Bumpus** and **Charlie Hieken** received awards last year for outstanding success as Class Agents and **Gerry Lyons** received a commendation for his outstanding work with Special Gifts in the Boston area. **Breene Kerr** also received a Certificate of Appreciation as a member of the Alumni Fund Board from 1967 through 1969.

Roy Sachs is taking his sabbatical leave from the University of California at the Plant Sciences Laboratory, Fort Detrick, Frederick, Maryland until August 1970 and would like any easterners (or westerners) to drop in for a visit. . . . **Bert Schweizer** writes that he is back in Tucson again, as professor of math at the University of Arizona. . . . Alcoa has moved **Robert Stephenson** from chief I.E. at the Point Comfort operations to project manager, powder and pigments at the Pittsburgh office. . . . **Sanford Sussman** has joined Computer Diodes Corp. as executive vice president and chief operating officer of the corporation which has plants in Fair Lawn, N.J., and Philadelphia and Hazleton, Pennsylvania. They make semiconductors, solid state electronic components, and electronic equipment. We had a nice note from Sandy after Ellie and **Howard Levingston** bumped into him and his wife Judith in the casino at Caesar's Palace in Las Vegas. Sandy was en route home from an electronics convention on the West Coast.

Cornelis Van Mook is principal naval architect for Dravo Corp., Engineering Works Division in Pittsburgh, Pa.

Herb Woodson was honored as one of the outstanding professional contributors to electrical engineering by the I.E.E.E. He was elevated to "Fellow" status with the citation, "For contributions to teaching and research in the areas of energy conversion, electric machinery, and power-systems technology."—For this month—**Paul G. Smith,** Assistant Secretary, 11 Old Farm Road, North Caldwell, N.J. 07006; **Howard L. Levingston,** Secretary, 358 Emerson Road, Lexington, Mass. 02173; **Walter Davis,** Assistant Secretary, 346 Forest Ave., Brockton, Mass. 02402; **Marshall Alper,** Assistant Secretary, 1130 Coronet, Pasadena, Calif. 91107

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Bob Anslow has been promoted to vice president of the Roanwell Corp. . . . **George D. Becher, Jr.,** named 100,000th citizen of Davis County, Utah, was honored with his family at the opening night of the Davis County Fair. George is branch manager of the American Pad and Paper Company's new plant in North Salt Lake and resides in Bountiful with wife and five-year-old daughter Susan.

Coley Bresee, who served with the San Mateo County District Attorney's Office for one and one-half years, is now an assistant United States Attorney in San Francisco, assigned to the Criminal Division. . . . **Davis S. Fields, Jr.,** is a senior engineer/project manager at IBM's Endicott, N.Y., Manufacturing Research Laboratory.

E. C. Hinck has been promoted to manager of engineering and development at Ingersoll Rand's Portable Compression Division. He is married to the former Anneliese Riehl and they have two children, Audrey, 10, and Taylor, 7.

Arthur Hughes has recently published two articles; "Desired Characteristics in Automated Display Consoles," and "Trends in Display Consoles Characteristic to Meet Growing Demands." Art is now senior consultant in product and market planning in the Commercial/Industrial Division, Auerbach Associates, specializing in computer graphics systems, both soft and hard copy, particularly CRT displays.

Stanley Kolodkin has been appointed manager of Tactical and Space Programs for RCA's Aerospace Systems Division in Burlington, Mass., where he is responsible for a variety of systems including the Apollo lunar module landing radar, low light level TV and laser systems, and classified electronic countermeasure systems. . . . **Arthur Kaplan** has formed his own corporation along with two colleagues. Named Systems Science and Engineering, Inc., the firm will specialize in computer simulations and modeling, systems analysis, and applications of radioactive isotopes.

Richard Mills has resigned as director of Information Processing Services at M.I.T. . . . Colonel **N. R. Rosen** is now serving as chief, Lines of Communication Division, Construction Directorate, Military Assistance Command, Vietnam, where he is responsible for construction of roads and bridges on a 4,000 kilometer primary highway network. He also serves as advisor to the director general of highways.

Paul Stern is presently with Isaacs-Dobbs Systems, a small (22 member) firm that specializes in the development and marketing of time-shared computer systems. He is responsible for both system design and company administration. He and wife Marilyn have two children: Deborah, four years, and Adam, one year old. . . . **Paul Valerio** sends regards from Sooren Soovajian (at IBM, Kingston), Martin Raab (associate with Harnes, Lundlung Wahler, Architects), and John Zarcaro (at NASA).—**E. David Howes, Jr.,** Secretary, P.O. Box 66, Carlisle, Mass. 01741

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Guess we'll be seeing many of you soon in Prouts Neck and Cambridge—pleasant thought. Bring along pictures of your dogs, cats, children, boats, houses, offices, plants, etc.—even of yourself fifteen years ago if necessary.

Lots of activity reported lately including a few cross-country moves: **Dick McCammon** has left Seattle and is now in Columbus, Ohio, with Management Horizons. **Dan Stewart** is no longer in Houston, but in Baltimore, as associate in charge of design for Meyer, Ayers, Saint. **Larry Coffin** has left the V.A. Hospital in Cleveland, where he was chief of thoracic surgery, to become associate professor in the department of surgery at the University of Vermont College of Medicine in Burlington. **Ed Pulsifer** wrote last fall that he had moved from Cleveland to California as sales manager at Hewlett Packard's Cupertino division, which manufactures computers and digital systems. **John Lindenlaub** et al have returned to Indiana, John to his teaching at Purdue, after a very busy and exciting year in Andover, Mass., where John was with Bell Labs. That family (Brian is eleven now; Mark, nine; Anne, seven; David, five; Debby does not reveal *her* age . . .) saw more of New England in a year than many New Englanders ever see!

Gadabout **Norry Hersey** reports a relatively dull year— only two trips to Germany and one to Hawaii outside the U.S., and recommends the skiing in New Mexico ("in lieu of the Alps, but one can't have everything!"—alas.)

The less mobile members of the Class have been "on the move" too. **Bill Friedman,** who in February, 1969, became administrative vice president of Younkers, Iowa's largest department store, and in May was elected to the board of directors, serves also on the boards of the Iowa Business Credit Corporation, the Des Moines Community Foundation, the Iowa Des Moines National Bank, and the operations division of the National Retail Merchants Association. In his "spare time" he serves as president of an indoor tennis center (four courts, expanding to six) with 500 members, which in January sponsored a benefit for the new million dollar Des Moines Science Center (3000 people turned out to see Stan Smith trim Arthur Ashe).

Charles Rockwell has been promoted to engineering manager-controls by Fenwal Inc., of Ashland, Mass.; **Tom Smith** of Brighton to vice president-engineering for IKOR Incorporated; **Jim Kennedy** to senior process engineer in the headquarters office of Stone and Webster in Boston. Jim and Marcia and their two children live in Sherborn.

Kevork Balekdjian is a member of the component and network testing group at General Radio, West Concord. . . . **Bob Schlomann** continues as head of research with the American Electric Power Service Corporation in New York City. . . . **Fred Brooks** reports breeding thoroughbreds "at home on the farm" in addition to his work at Serendipity, Inc., in Arlington, Va. . . . **George Marcou** and Margaret (nee Carmody, M.S., 1954, Course XVIII) and their five children live in Washington, D.C., where George is president of Marcou, O'Leary, and Associates, a planning and urban development consulting firm recently acquired by Westinghouse.

Debby and **Joe Saliba**'s second boy was born last July. Joe is systems assurance manager for the eastern region at IBM. **Harlan Walker** has become a mortgage holder, with a house in Lakewood, Calif., *and* a father, Michael Harlan having arrived in October. Harlan is with Lockheed, his wife at McDonnell-Douglas —for a bit of friendly competition. . . . **Allan Boardman,** director of an analysis group at Aerospace Corporation, writes that he and Lina and their "three housed apes are living life to the fullest—by very local definition" (Los Angeles area). He wants to know how come '55 doesn't have a spot near the back cover of the *Technology Review* as we used to; suggests maybe distance from eyebrow to hairline is proportional to distance of notes from back cover?—Secretaries: **Mrs. J. H. Venarde** (Dell Lanier), 16 South Trail, Wilmington, Del. 19803; **L. Dennis Shapiro,** Aerospace Research, Inc., 130 Lincoln Street, Boston, Mass. 02135

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Return of the questionnaires sent out with Class President Malster's letter last fall have been somewhat disappointing in quantity—fewer than one score. However, those few bring words of interest which your Secretaries gladly transmit.

Ed Zoolalian reports that he is now manufacturing manager for Neff Instrument Corp. He and Denise have been visited in California by eastern classmates Wendy Reis, and Elaine, and Ed and Dori Baker.

A release from F.I.T. (just pick a state that begins with "F") informs us that **Lamar Washington,** President of ORCA, Inc., of Cambridge, Mass., plans to join others at the New Draper Center in developing a device to eliminate electric power blackouts. . . . **Art Sirkin** has forsaken his engineering career to become a registered representative with Walston and Company. Benita says she's glad the new job doesn't keep him away from East Brunswick so much. They have two children. . . . Parents of twin boys and one daughter are Carolyn and **Fred Lupi.** Fred works for Rochester Gas and Electric. He attended the A.S.C.E. meeting in Chicago last fall where he bumped into John Wenning.

Ed Boggs, who specializes in soil mechanics, has been an active alumnus, serving both as an educational councilor and Harrisburg Alumni Fund chairman. In his "spare" time, he's a major in the air national guard, piloting EC-121's. Norene reports they have two children. **Harris Weinstein** has returned to private law practice in Washington, D.C., with the firm of Covington & Burling,

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Due to a change in the academic calendar, the dates for all future reunions and commencements are subject to revision. Our 15th reunion will be held on June 4-6, 1971—a week earlier than otherwise planned. Reunion Committee Chairman Bill Grinker advises that the new dates have already been cleared with the Harbor View Inn in Edgartown on Martha's Vineyard. See you there!

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after serving a period in the Department of Justice. He and Rosa are parents of two. . . . **Stanley Hart** is doing basic research in geochemistry and geophysics at the Carnegie Institution of Washington. He attends numerous professional meetings, has written many papers and part of a book, and in his spare time is building a harpsichord. . . . **Eugene Amazon** writes that he is now director of sales, management information services at Investors Overseas Services in Geneva.

Frederick Jelinek recently authored an article in the *IBM Journal of Research and Development* with the title of "Fast Sequential Decoding Algorithms Using a Stack." During 1968-1969 Fred was on a sabbatical leave from his position as Associate Professor of Electrical Engineering at Cornell to work at the Thomas Watson Research Center. Also during 1969 his book *Probabilistic Information Theory* was published by McGraw-Hill.

Melvin Levine reports that after ten years as planning director for downtown progress in Washington, D.C., he has accepted a position with the Rouse Company in Columbia, Md. . . . **George Somekh** co-authored an article on aromatic hydrocarbon separations in the December 1969 issue of *Hydrocarbon Processing.* George performed the research in this field in line with his work as a project engineer in the research and development department of Union Carbide's Chemicals and Plastics Division.—**Bruce B. Bredehoft,** 3 Knollwood Dr., Dover, Mass.; **T. Guy Spencer, Jr.,** 73 Church St., Weston, Mass. 02193

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All the way from the other side of the world (Honolulu) arrived a letter from **Harry Flagg.** He enclosed an annual report from his firm Telecheck International, Inc., which shows substantial progress in sales and earnings. Telecheck has acquired a number of firms in the last year and now is quite diversified. Harry's letter read in part: "It has been some time since we have talked so I just thought I would send you a pile of information on what's happening out here. You will notice that Bill Daly, Class of '58, is a close associate of mine, and we are having a hell of a lot of fun in the progress of building our company. Things hit a climax about a month ago when we listed our stock on the Pacific Coast Stock Exchange. We are hopeful on being on the American Exchange in the next 8-12 months."

Michael Schneider writes us as follows: "This is just a short note (my first to *Technology Review* since graduation) to indicate that I have returned to the womb of Cambridge living on Harvard Street, a few minutes from the Institute. I was formerly with the Kearfott Division of General Precision engaged in computer design, holding the position of chief engineer for advanced computer technology. I have now joined Compu-Systems Company in Wakefield, Mass., as general manager and director of engineering. This new company, a subsidiary of Gordon Engineering, is a computer applications/systems house and has several contracts to manufacture computer-based systems, to design special purpose computers, and to prepare production drawings for digitally based products for clients. The field is exploding simultaneously in several directions and therefore I keep fairly busy. On a personal level I suppose I'm one of the few surviving bachelors. I hope to write again before another thirteen years."

A recent biographical note in a technical journal on **Tom Ahrens** reads as follows: "Tom Ahrens received his B.S. degree in geology and geophysics from M.I.T. in 1957 and an M.S. from the California Institute of Technology in 1958. He received his Ph.D. in geophysics from Rensselaer Polytechnic Institute in 1962. He has worked in the areas of exploration seismology with the Pan American Petroleum Corporation in ground-shock studies while on duty with the U.S. Army, and in shock propagation in earth materials at Stanford Research Institute's Poulter Laboratories where he was chairman of the Geophysics Section. In 1967 he joined the staff of the Division of Geological Sciences at the California Institute of Technology as an associate professor and is currently conducting shock wave research at the Caltech Seismological Laboratory. His research interests include high-pressure physics, particularly material properties of earth and planetary interiors, and shock and ultrasonic wave propagation in solids."

John Collins, electronic division manager of Analog Technology Corporation, Pasadena, Calif., writes that he is looking for outstanding electronic design engineers. John's firm develops scientific instruments for NASA and DOD. . . . There are quite a few tidbits for next month's issue.—**Frederick L. Morefield,** Secretary, Tiirasaarentie, 17, Lauttasaari, Helsinki 20, Finland

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We received this note from **Arthur Alexander:** "Since this is my first letter for the class notes, there is a lot of updating to do. Briefly, after M.I.T. graduation I spent six months in the Army, three years with IBM in Poughkeepsie, two years at the London School of Economics where I received an M.Sc. in economics, and three years at Johns Hopkins University. My Ph.D. dissertation in economics was completed last year and the degree was duly awarded by Johns Hopkins. For the past year and a half I have been on the research staff of the Economics Department at the RAND Corporation in Santa Monica. Just prior to going to London in 1963, I was married to the former Elaine Averich, and we now have a daughter Sarah, 1½ years old." . . .**Daryl Wyckoff** is now living in Marblehead, Mass., with his wife and 2 daughters, while he is at Harvard Business School as a candidate for the degree of Doctor of Business Administration. Daryl was one of the 1970 recipients of the William Barclay Harding Memorial Fund which supports studies of candidates for this degree in the field of aerospace management. In 1968 he graduated from U.C.L.A. with an M.B.A. degree in marketing.

Lewis Bastian has been promoted to the position of senior programmer at IBM's Systems Development Division Laboratory which is located in San Jose, Calif. He has been with IBM since 1963 and most recently was at IBM's Palo Alto Systems Research and Development Center before assuming this new position. He and his wife Donna have four children: Laura, Bertha, Barbara, and Karen.

Benefiting from recent grants and awards from the National Institute of Health to the Salk Institute in San Diego, Calif., was **Paul Knopf** who will continue research on the formation of gamma globulins produced by plasma cell tumors. Paul also received a career development award from the N.I.H. . . . In Argentina, **Reinaldo Richardson** has been appointed general manager of manufacturing for John Deere's facility there. . . . **Paul Chorney** is now with Unitrode Corporation in Watertown, Mass., as technical director of the Microwave Division.

Martin Levin has been promoted to Associate Professor of Sociology at Emory

University in Atlanta, Ga. He received his Ph.D. from Johns Hopkins in 1967. . . . **Richard Linde** is a partner in the recently formed architectural firm of Linde-Groth in Sheboygan, Wis. He is currently president of the Sheboygan County Chapter of Big Brothers of America and is also in Boy Scouts and Y.M.C.A. work. He and his wife, Constance, have four children. In addition to all these duties, he has also been appointed to the City Plan Commission. . . . In attendance at the recent M.I.T. Mexico City Fiesta were: Joaquin Garcia Barcena, Masaru Turu, and Iris and Luis Unikel Spector.

At the Armed Forces Staff College in Norfolk, Va., Major **Walt Ackerlund** has been decorated with the Silver Star for gallantry in combat. He also received the Distinguished Flying Cross, Bronze Star and ten awards of the Air Medal for achievements in his 12-month Southeast Asian tour completed last July, during which time he flew 316 combat missions. . . . And in Vietnam, Major **Ellis Braman** was decorated with the Meritorious Service Medal at Tan Son Nhut Air Base.

At the National Radio Astronomy Observatory in Greenbank, W. Va., **David Buhl** is part of the Radio Astronomy team which recently reported on their findings of formaldehyde widely distributed in the clouds of dust and gases existing in interstellar space. Their findings are highly significant because it is the most complex molecule yet discovered in space and is believed to play some role in the origin of planetary life forms. . . . **Roy Thorpe** has been appointed president of Fluid Handling Systems, Inc., a recent acquisition of Falcon Safety Products, Inc., of which Roy is vice president. Fluid Handling Systems was previously known as the Viking Pump Company of New York. Roy continues in his post of vice president at Falcon.

Charles Diebold has become chairman of the Western Savings Bank of Buffalo following the resignation of his father from that post to become president of the First Empire State Corporation, a newly formed holding company that is the sole owner of the Manufacturers and Traders Trust Company, the second largest commercial bank in Buffalo.—**Michael E. Brose,** Secretary, 199 Sudbury Rd., Concord, Mass., 01742; **Antonia D. Schuman,** Assistant Secretary, 22400 Napa St., Canoga Park, Calif.

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Bill Eldridge says that he and Charlene are planning to be at the reunion. (June 12-14 at the Jug End in South Egremont, Mass.) If they're coming in from Washington (the state), how can we do less? Bill has been working for Boeing since 1960; he spent several years in research, developing airplane stability augmentation systems, high lift flaps and new wind tunnel designs. He worked on the SST for a few years and is now working on new airplane technology. He and Charlene have a two-and-a-half year old son, David. Bill is vice president of the Seattle Alumni Club.

Doug Sinclair has been promoted to Associate Professor of Optics at the University of Rochester Institute of Optics. In 1968 Doug received the Adolph Lomb Medal from the Optical Society of America for his work on lasers.

Jerry and **Barbera Stephenson** became parents on March 1: Thomas James Stephenson weighed in at 9 pounds. . . . **Martin Somin** and his wife had a daughter, Lynn Meredith, on November 18, 1969. . . . **John Schaefer** is a student at Stanford in the Economic Development Planning option of Industrial Engineering. John and Sue have two children—Christopher and Kirsten—and are living in Los Altos Hills, Calif. . . . **Bruce Silberg** is with the New Jersey office of a California-based firm, Computing and Software. . . . **Howard Hillman** is manager of Engineering Applications at Gamat Systems, Inc., in New York City.

Bill Nicholson received his M.B.A. from the evening program at Pacific Lutheran University in Tacoma in June 1969. He is now with the Pacific Northwest Laboratories of Battelle Memorial Institute and is living in Richland, Washington. . . . **Steve Pollock** is teaching operations research at the University of Michigan; he is an Associate Professor of Industrial Engineering there. . . . **Robert Wolf** is on sabbatical from Harvey Mudd College, he is working in philosophy of science and low temperature physics at Oxford (England) on an N.S.F. Science Faculty Fellowship.

Doug Knight writes saying he is "a po' grad student at A.S.U., having just survived my third year. My family loves it in Arizona even if Daddy stays up late at night. I've been elected student chairman of our Association for Computing Machinery, and have been busy soliciting memberships. I wouldn't mind soliciting some M.I.T. cast-off computers while I'm at it. Anyhow, old Doug has been plenty active." . . . **Sheila Widnall** has been appointed to the new M.I.T. Commission. Sheila is an Assistant Professor of Aeronautics and Astronautics at M.I.T. The Commission will investigate the future of M.I.T.

Byers G. Smith died on November 13, 1969. He was living in Thousand Oaks, Calif., at the time.

These notes are coming to you from the Bahamas: Chris and I are spending a week here with the kids. Our major activity so far has been making the rounds from the patio (where we sit), to the water (where we swim) and the bar (where we sit again). We'll be in fighting trim for the reunion. See you there.—**Linda Sprague,** 10 Acorn St., Cambridge, Mass. 02139

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Ahh, Spring! We had about a foot of snow here-abouts in early April. All the lazy people who had forgotten to replace their snow tires were vindicated and sneered at their brethren stuck in snow drifts.

The snow washed away in several inches of rain and now we are living in a typical New England spring of mud. If it looks to you as though I'm padding the column this month you're correct. Only four cards arrived during the last several weeks. Spring fever?

Joe Davis writes that he is "still working as a performance supervisor for Delta Airlines in Atlanta. I talked on the phone to **Brent Silver** and **Merlin Dorfman,** two other Course XVI graduates who seem to be enjoying the San Francisco area—Brent at Stanford, Merlin at Lockheed. I'm finishing up a year as chairman of the Atlanta section of the A.I.A.A. I have a wife and two daughters, 4 and 2 years old." Thanks for all the news, Joe.

Al Crisi wrote saying that he is still teaching math and science in the Estes Park Jr-Sr High School and is enjoying the Denver Area. . . . **Ian Clark** left Honeywell nearly a year ago after "a good eight-year relationship" and is now the managing director of the Toledo Scale Co., in Mexico. . . . And finally **Marshall Greenspan** says he got his Ph. and D. from the University of Connecticut a year ago.

That kills the letters, but there are always the press clippings. One press release that particularly interested me was from Bell labs telling how **Angelo Lamola** and others there have "developed a way to introduced into DNA very specific chemical changes with ultraviolet light." This sort of work is right up my alley and from other sources I have learned that the Bell labs people are putting thymine dimers into viral DNA with UV to see what happens to the viruses. Might lead to some very interesting results. But why at Bell Labs? Come to Brandeis where you will be loved, Angelo.

Out of General Electric comes word that **Craig Tedmon, Jr.,** and others had designed an electric motor which can run at 1,400 degrees. The wiring of this remarkable motor was made of a silver-palladium alloy which, when heated above 150°F creates its own insulation as the nickel changes to nickel oxide.

Delectable Tidbits

Princeton University reports that **Philip Pochoda** got his Ph.D. in sociology in February. . . . **Jim Keller** who is an assistant professor of philosophy at MacMurray College, in Jacksonville, Ill., received his Ph.D. from Yale in January. The title of the thesis was "The Concept of Divine Action." (Something about Newton's second law no doubt.) Jim has been at MacMurray since 1967. The Kellers have two children, Pamela, 6, and James, Jr., 4. Jim's official history is creeping with honors, the most recent was chairmanship of the Central States College Philosophy Professors Association.

Captain **Dwight Kennard** is still in the air force at Hamilton AFB in California. . . . One of the co-winners of the Arthur Wellington Prize of the American Society of Civil Engineers was **Joseph Wright** for the paper, "Ground Shock Due to Raleigh Waves from Sonic Booms." The blurb says that Joe has been working at the consulting firm of Paul Weidlinger since 1964. . . . **Alexander Rutchka** has been promoted to staff engineer at the I.B.M. Systems Development Lab at Kingston, N.Y. . . . **John Deutch** is now an associate professor of chemistry at M.I.T. . . . Also at M.I.T., **Gerald Wilson** is working at the new Electric Power Systems Engineering Laboratory. . . . **Robert Holt** is now working for Schick Safety Razor in Milford, Conn., while **Richard Brown** has left the blade business at Gillette and moved on to Addressograph Multigraph in Cleveland, Ohio. . . . **John Castle** is director of research at M/K Systems, Marblehead, Mass., a company which makes test equipment for the paper industry. . . . **Edwin Wilson** was made a member of the New York Academy of Sciences not too long ago. . . . **James Seppala** is now a relay applications engineer at Sigma Instruments in Braintree, Mass.

That clears my desk and you shall hear no more from me until you write or convince the PR department in your place of work to write.—**Andrew Braun,** Secretary, 131 Freeman St., Brookline, Mass. 02146

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David B. Knaff is a co-discoverer of two new reaction steps which have brought the process of photosynthesis into clearer focus. His work is being performed at the University of California, Berkeley.

Herman Schneider will be associated with the newly created Electric Power Systems Engineering Laboratory at M.I.T. This laboratory will involve professors and activities from the Electrical, Mechanical, and Nuclear Engineering Departments. Herman is on leave for a year and, according to a friend of mine who traveled next to him on a plane, is at Watkins-Johnson Co. in Palo Alto, Calif.

Thomas P. Sheahen spoke on behalf of Southwestern Bell Telephone in Dallas in March on the relation between science and society. . . . **Bob Elliott,** a classmate of mine at Stanford Business School, is now a manager in the Administrative Services Division of Arthur Anderson & Co., specializing in EDP. He is married, has one child, and is living in a semi-renovated Victorian in San Francisco. **Steve Smith** is now an instructor in the Physics Department at Princeton. **Keith M. Ferguson** is working in the Santa Clara office of Hewlett Packard and had an article in the *H-P Journal* on the computing counter keyboard. . . . **Martin C. Poppe, Jr.,** is manager, advanced development at Beukers Laboratories, Inc. in Hauppage, N.Y. **Stephen B. Kukolich,** assistant professor of chemistry at M.I.T., was married last August to a Cornell alumna, the former Ann Marie Olson.—**Gerald L. Katell,** Secretary, 13751 S.E. 20th Street, Bellevue, Wash.

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I received no letters from classmates this month, but fortunately I have been sent the news that many of you have written on your alumni fund envelopes. . . . Captain **Joe Boling** is stationed at the Army Adjutant General School in Indianapolis, where he is in training as a career officer. He has a three-year-old daughter, and by the time of this issue he should be the father of a second child. **Thomas Daniel** is studying oceanography at the University of Hawaii with N.S.F. sponsorship. . . . **Dominic Desiderio** is an assistant professor of chemistry at Stanford. He was married in October of 1965 and has one daughter.

James Dorr is acting editor of Indiana University's computer center monthly journal. . . . **David Evans** received his Ph.D. in electrical engineering at M.I.T. last June, and is working at Analytics, Inc. in Burlington, Mass. He and his wife Betsy have two children.

Richard Fisher notes that he is alive and well and single (he doesn't claim any cause and effect relationship!). . . . **Daniel Frischmuth** is the product marketing engineer for the Microwave Division of Hewlett Packard. He was the author of an article concerning technical problem-solving in the May, 1969 issue of *IEEE Transactions on Engineering Management*. . . . **Ernest Henrichon** received his Ph.D. in electrical engineering at Purdue. He is now a project scientist at Infoton, Inc., a Waltham company specializing in communication sciences. . . . **T. A. Marnane** is a Navy commander in Rhode Island, where he is attending both the Naval War College and the University of Rhode Island. . . . **John Meriwether** is working for NASA at Goddard. He recently went to Alaska on a project to study the electrical fields in auroras.

Cary Mock is employed as an industrial sales engineer in Buffalo. He married the former Gail Salotti on July 5, 1969. . . . **Gary Owen** is an economist with Dome Petroleum. . . . **Len Parsons** was the author of an article on sales analysis in the May, 1969 issue of *Applied Economics.* Currently he is working on an advertising analysis project pursuant to a grant from the American Association of Advertising Agencies. Leonard Jon, Jr., was born on May 6, 1969. . . . **Bob Quackenbush** has received his Ph.D. in math from Stevens Institute of Technology, and is now a post-doctoral Fellow at the University of Manitoba. . . . **Bill Roberts** is teaching at the University of Virginia. He and his wife Linda spent last summer at our reunion, then at an astronomy institute in New York, and finally they went to an astronomy symposium in Switzerland.

Maury Shulman is working as a systems engineer for IBM in Philadelphia. Maury is engaged to Rena Cittrons, a graduate of Temple University and a language teacher in junior high school. . . . **Sezer Soylemez** is expecting his Ph.D. from the University of Pennsylvania this June. . . **Glenn Stith** is employed in the Computing Research Division of Pan American Petroleum Corporation in Tulsa. . . . **Carl Uhrmacher** is working for ESSA as an engineer, while his wife Barbara is employed by Scherring Corp. as a programmer. . . . **Bill Young** is working for IBM at its Research Center. He married the former Linda Rudin of New Rochelle last May, and they now live in Mt. Kisco, N.Y.

Let me hear from some of you!—**Ron Gilman,** Secretary, 5209 Peg Lane, Memphis, Tenn. 38117

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Kim Kimerling is a first lieutenant in the air force and is at Hanscom Field doing semiconductor research. . . . **Cash Peacock** was recently discharged from the army as a first lieutenant, after serving two years as the special projects officer for the Transportation Command Data Processing Center. He is currently working at his father's construction company in Waltham, Mass.

Hank Lichstein recently published an article in the November 1969 issue of *Datamation* analyzing the alternatives to reprogramming upon the introduction of new data processing equipment. He is now the director of advanced computer techniques in the Office of the Assistant Secretary of Defense (Comptroller). Hank's wife is running a ballet school in the Washington, D.C. area. . . . **Jon Hanson** has been promoted to technical service representative at Hooker Chemical in Tacoma, Wash. . . . **James Pearson** has joined International Nickel's research laboratory in Sterling Forest, N.Y. Jim finished his Ph.D. in metallurgy at M.I.T. in 1969. . . . **Richard McMorrow** has been transferred to Hewlett Packard's Waltham Division. The McMorrows' third child was born in February.

John Beckmann is now at Peat, Marwick, Mitchell & Company, Washington, D.C., as a consultant specializing in financial management systems. . . . **Richard Molari** is now development engineer with GE's Chemical Development Operation in Pittsfield, Mass. . . . **David Kettner** is currently working for Lincoln Laboratory as a liaison to the USAF Space and Missile System Organization at Norton AFB, Calif. He married the former Miss Caroline London in February, 1968. . . . **Herbert Mower** married the former Miss Frances McConnell, a Wellesley graduate, last May.

John Holdren published an article in the December issue of *Bio-science* relating technology and population control. He also presented a paper on relativistic plasmas in the May issue of *Physics of Fluids.* John is currently finishing his Ph.D. work at Stanford and will soon join the Lawrence Radiation Laboratory. . . . **Erick Jordahn** is at the University of

Washington as an assistant director of engineering research—**James Wolf,** Secretary, Brigham Rd., Gates Mills, Ohio

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Not much in the mailbag this month, so we'll use most of the column to catch up on the holdovers from the last issue. I have just returned from a month-long trip to the U.S. and saw Nan and **Jack Elder,** Sandy and **George Berbeco,** and Elisabeth and **David Mundel.** Jack is still in the Mechanical Engineering Department, hoping for his Ph.D. later this year. Jack and Nan were kind enough to put me up for the length of my stay in Boston, although the Mundels and Berbecos each did their share by putting on delicious dinners for me. George is now the assistant to the president of Moleculon, Inc., a chemical engineering outfit located in Kendall Square. He is also taking courses part-time in the Sloan School. David plans his Ph.D. sometime during the summer, while he continues his consulting work with various places in D.C. and on the West Coast. At the M.I.T. Placement Office, I met with **John Davis** who was there interviewing for Bell Helicopter. He said that he works in the same group as **Paul Lindsey.**

On my desk upon returning to Oxford was a letter from **Larry King.** He scolded me for giving him a premature promotion a couple of issues ago, saying he will not receive his captain's bars until May. He reports that **Woody Stoddard** is also in Dayton, Ohio, as a second lieutenant. Larry and Janet's big news, though, is the impending arrival of their first child in June. Preparation for that glorious event and pampering a "new" 1959 Ford fill up their spare time quite well.

Joining Larry's letter was one from **Marty McGowan, 3rd,** who is now in Sinop, Turkey, courtesy of the Department of Defense: in March he returned to Washington, D.C. where he plans to study operations research at George Washington University, also courtesy of DoD. In June he plans to marry Patricia Ralicki in Pittsburgh. They met rather casually and fell in love while both were in Europe last fall. Pat holds a masters in math from Ohio State. Marty earns the Hero-of-the-Month Award for the following blurb on Turkey: "The U.S. presence is very much felt in this eastern-most of the NATO countries, especially when one considers the size of our commitment here (just under 25,000 Americans in the direct or indirect employ of State and Defense Departments). Any visit of the Sixth Fleet is always welcomed with the usual demonstrations from the students in Istanbul. One of the most humorous incidents of the past two years occurred shortly after our Apollo shot in December 1968. Our embassy in Ankara was picketed by some irate and rather illiterate peasant farmers who had been convinced by their local Hoja (holy teacher) that a rock shower (that's right, a shower of rocks—must have been hail stones, as December is the moist month here) which ruined their crops was caused by our moon exploration. Which, of course, was poking holes in their sky. 'Chicken Little' is alive and well in Turkey. Even the Russian Embassy did not escape their wrath."—**Terry J. Vander Werff,** Secretary, 24 Horwood Close, Oxford, England OX3-7RF

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As I write this, it occurs to me that I will soon be returning to the United States. Where have the past two years gone? My Peace Corps experience has been worthwhile. While trying to help others, which is often difficult, I have received a broad education that I believe is superior to any education I would have received in the States in that time. An often-raised Peace Corps question is: Who gains more, the volunteer or the host country? I have no good answer to this question, but I know I have changed a lot. My involvement with Moroccan problems has helped to shape my outlook on U.S. and international problems. I would be happy to hear from anyone who has any questions about the Peace Corps. After the middle of May please send any correspondence to my home address which is found at the end of this column.

Class news would be much shorter if we didn't have any news from those in the armed forces or from those who are on the outside thinking of that pleasant possibility. Almost half the news this month is of this nature. . . . **Kenneth Barbour** writes that he is stuck in the army until February 4, 1971, and that his wife likes the *Review*. . . . **Greg Wight,** recently promoted to first lieutenant, is still stationed at the GE jet engine plant in Cincinnati. . . . **James Small** was drafted out of M.I.T. Graduate School in February, 1969. Fortunately, he received a direct commission from the army a week before he was to be inducted, and he's now in Germany. "I'll get out in February, 1971, and I can hardly wait to get back to Tech!"

Gilbert Smith is working in computer systems in the air force, having received his commission from air force OTS at Lackland in February. Also in February he married Miss Sharyn K. Jacob. . . . Airman First Class **John St. Peter** has graduated from the air force air traffic controller course at Keesler AFB, Miss., and has been assigned to Williams AFB, Ariz.

Andrew Goldsmith writes: "As you can see, the reforms in the Selective Service came too late for me. I was drafted July 15 and have accepted a direct commission as a captain in the Army Medical Department." . . . **Leonard Fenocketti** has completed basic training at Lackland AFB, Texas, and has been assigned to Keesler AFB, Miss., for training in communications electronics systems. . . . **Guillermo Arnaud** writes: "Well, I ran out of luck, and Uncle Sam finally got me. I recently finished basic training in Ft. Bragg, N.C. Now I'm waiting for my orders which I hope will be an assignment doing research in electronics." **Greg Facharias** is a second lieutenant stationed at the NASA Manned Spacecraft Center in Houston. He's working on guidance and control of the shuttle vehicle. Although Houston has much better weather than Boston, he still misses Boston.

Larry Galpin, while sweating the draft, is continuing as a research engineer in plastics for duPont in Wilmington, playing on an amateur soccer team, and studying for an M.B.A. at University of Delaware's night school. . . . **Terry Collins,** still single, has received his M.S.E.E. from University of Wisconsin and is working for the navy with the intention of returning to school eventually.

Donald Oestreicher reports a daughter, Heather Jasmine, 9 pounds 9 ounces, 19½ inches, born December 5, 1969. **Steve Persek** is teaching math at N.Y.I.T. and working on his Ph.D. in math at N.Y.U. . . . **Michael Mark** was elected vice president in charge of computer equipment by Intercomp of Cambridge. **Bruce Greenwald** has received an M.S. in electrical engineering and a master's in public affairs from Princeton.

Paul Goldstein in his third year at Washington University Medical School, has received a Lange Medical Publication Book Award for "high scholastic standing and achievement in research." He also received the award last year. After nine months at Weizmann Institute of Science, **Alan Perelson** is back in biophysics at Berkeley. . . . Cindy and **John Lindley** have a daughter, Robin, born April 16, 1969.

Robert Sarly has finished his thesis on new towns and regional planning in Israel and is now teaching fifth year architecture students gaming simulation techniques. He has won a grant from the National Foundation on the Arts and Humanities to do research comparing new towns in Israel to those in the States. He's planning to return to the States in July.

Last August **Mike Kruger** married the former Suzanne Korutz of Boston University. Mike, employed by the Navy Department in Washington is working on the development of a realtime control system for a new nuclear frigate. . . . I received the following note from **Jim Moorer:** "Hi. I'm married to a B.U. chick, working at Stanford Artificial Intelligence Project, going to school at Stanford in computer science and San Jose State in E.E. (simultaneously), and am a full-time hippie and rock guitar player. How's that?" . . . **Ken Ogan** is still in the Ph.D. program in the Department of Chemistry at U.C.L.A.

Jim Puls is serving as national financial manager for the Lutheran Student Move-

ment while working on a Ph.D. in computer science at the University of Arizona.

Mark Grossman is employed by R.C.A. in Princeton, N.J., as an operations research analyst. On November 22, 1969, he married former Susan Cohen of Clifton, N.J. They plan to live in Clifton.

John Ellenwood is an associate research engineer at Boeing Wind Tunnel Laboratories. His wife Cynthia gave birth to twins, Paul and Lorien, on July 16, 1969. John, an artificial kidney patient as of September, has an artificial kidney machine at home. . . . **Jesse Mase,** having received his M.A. in physics from Berkeley, is teaching high school near Pittsburgh. The pay is lousy, but it beats the army. . . . **Bob Karman** sent a little news about himself and a couple of classmates, **John Fittz** and **Steve DougLass.** Bob began working in aerospace primarily to keep out of the draft, but after two years he has become interested in some fields of electrical engineering. He's working for Hughes in an R&D group developing automated fault analysis techniques for real-time computer equipment. He's planning to begin part-time studies at U.S.C. next fall. John and Steve are on the staff of Campus Crusade for Christ. After receiving his M.B.A. from Harvard, Steve joined the planning phase of this campus ministry and has had a great opportunity to apply his M.I.T.–Harvard background to an operation that usually lacks such specialists. John is back in Massachusetts sharing his personal relationship with Jesus with college students.

Steve Slater is employed as a chemical engineer by the National Institute of Health, Bethesda, Md. He's planning to return to M.I.T. within two years to complete his thesis requirements for the Sc.D. degree. . . . **Isom Herron** is in his third year of graduate study in mechanical engineering. He writes that he's impressed by the increased social and political awareness now found in M.I.T. classes. . . . **Harry Otaguro** is a photographic engineer at Electronic Image Systems Corporation in Cambridge. On November 1 he married the former Deborah Gail Cheyne, Wellesley '69, of Mansfield, Mass. . . . **Christopher Scott** recently completed alternate service at Mass. General Hospital. . . . **Barbara Desmond Gilchrest** writes: "Now in third year of Harvard Medical School, enjoying it. Married to Byron Gilchrest, '66, enjoying it."

Michael Zuteck, who's working with TRW Systems Group in Houston in support of NASA, writes that the space program looks different from the inside. "Because of the dust cloud, the astronauts landed pretty well blind on Apollo 12. They feel that this may be a serious problem on subsequent missions. They get lots of dust from 200 feet on down. I am currently rehashing experimental data on landing radar accuracy at low altitude." . . . Since August, 1968, **Peter Grant** has been an auditor for Goodyear Tire & Rubber Co., investigating the financial operations of its overseas subsidiaries. He has conducted audits in Germany, France, and England. In 1970 he will go to Germany again and then to Brussels and Istanbul.—**Jim Swanson,** Secretary, Services Provinciaux, Beni-Mellal, Morocco (until May 15, 1970); 1816 First Avenue North, Grand Forks, North Dakota 58201 (after May 15)

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My efforts to get people to change their class affiliations to the right class seem to be paying off now. I've received a note from the Alumni Office that **Dan Green** and **Les Kramer** have opted to join the Class of '68 officially. What about the rest of you? Remember, it's painless—just drop a note to either me or the Alumni Office or call x4879 if you're on campus.

I've heard some comments that this column has presented a disproportionate amount of news about people in the military. I suppose this is true, however I don't know what I can do about it. The purpose of the column is to be informative and I think most of you consider it news when someone gets drafted. Gail and I print all the news we get, subject to the restrictions mentioned last month. We just hear a lot about people in the military. If you don't like it, drop us a line and tell us about what *you're* doing.

Only two wedding announcements this month. **Tom Penn** married Kathy Ziegler on September 6 and is now studying at Stanford Business School. He reports having a long lunch with **Ben Roach** on the first day of school. . . . **Gary Anderson** was wed to the former Linda McNealy, a Wellesley graduate, on August 23. Gary is working on the Apollo project at North American and plans to receive a master's in aerospace engineering from U.S.C. in June.

Selective Service Stories

Airman **Carson Strong** has been assigned to Lowry AFB, Colo. for photography training. . . . **Keith Kallberg** is in Navy OCS at Newport, R.I. and expects to go to California for additional training after commissioning. . . . Lieutenant **Lester Small** is assigned to the Turbine Engine Division, Aero Propulsion Lab, Wright-Patterson AFB, Ohio. . . . From change of address forms I receive it sometimes becomes apparent that someone is in the service. For example **Frank Sheeman** and **Richard Swenson** now prefix their names with the title Lieutenant. Similarly the following three classmates now "live" in APO San Francisco: **Neil Clark, John Haynes,** and **Robert Wyatt.** Finally **John Arnold** is at the Yuma Proving Grounds, Ariz., and **Dana Sheldon** is at Meridian NAS, Miss.

Is military service inevitable? **Frank Allegra** doesn't think so. In the winter of 1969 he was a grad student at M.I.T. Then last summer he worked in experimental space physics. Now Frank is a full time draft counselor in the lower East side of New York. After being 1-A for 20 months, having three appearances before his draft board, and two appeals to the state board he was reclassified 1-0 (conscientious objector). From his experience as a draft counselor he is "convinced you don't have to go into the military or sell out to the system if you make the decision not to."

Riva Poor is editor of the *Minority Business Opportunities Newsletter* which is published by the Action for Boston Community Development (ABCD) and is "chock full of practical information for local entrepreneurs." . . . **Curtis Marx** writes that he is working towards a Ph.D. in chemical engineering at the University of Wisconsin, studying ionomer polymers. His wife, Becky, will receive a B.S. in math this year. Their son Jeffry recently celebrated his second birthday and as a result now greets them with "Happy Birthday" at the top of his lungs every morning. I've heard that some college towns are rough, but Curtis isn't taking any chances with Madison and writes "I am still continuing fencing and have also started to learn karate." Now, it couldn't be that bad. . . . **Mark Green** received an M.A. in math from Princeton in February. . . . Back at M.I.T. **Ed Seykota** is working on the DSR staff at the Sloan School on urban studies, and **Charlotte Babicki** is now a regular employee at the Draper Lab (nee IL) working on technical writing for Apollo. She formerly had worked there on a temporary basis. . . . **Jerry Grochow** has been promoted to assistant to the director of Information Processing Services with responsibility for the Multics system.

Richard Mushotzky is studying for a doctorate in physics at University of California in San Diego after having worked for Westinghouse to dodge the draft. Having #341 he isn't very worried about that anymore. He comments, "California is great compared to cold Cambridge." . . . Well, you don't have to live in the continental U.S.; **Sanford Kornfeld** got away from it all and is now in sunny St. Thomas, U.S. Virgin Islands.

That's all for this month. In June the feminine touch will return when Gail writes the column, so watch your mailbox for that issue.—**Gail** and **Mike Marcus,** Class Secretaries, Eastgate Apt. 16A, Cambridge, Mass. 02142

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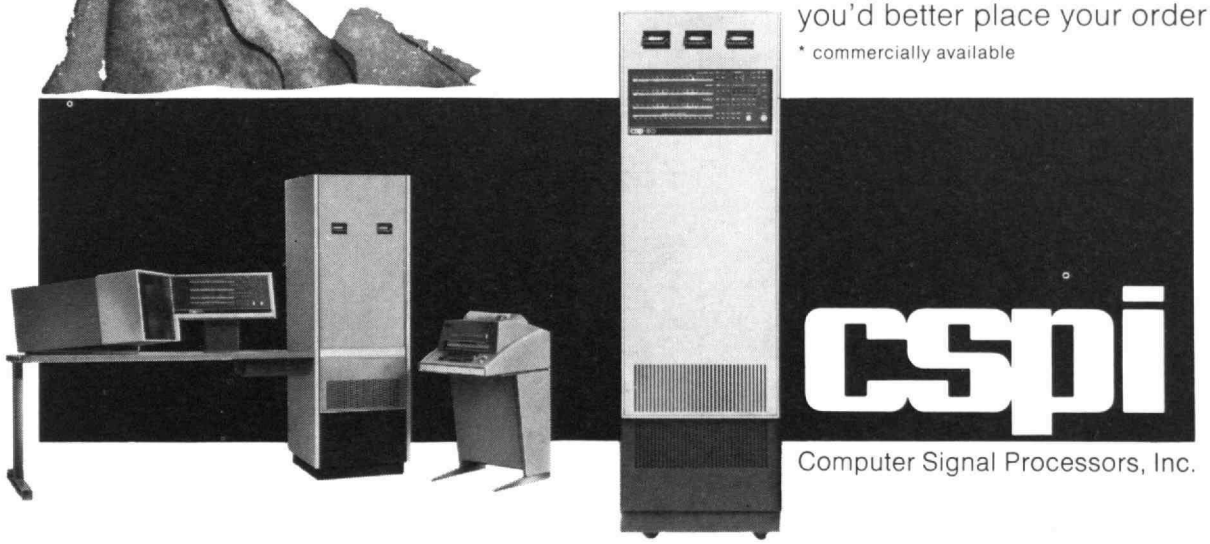

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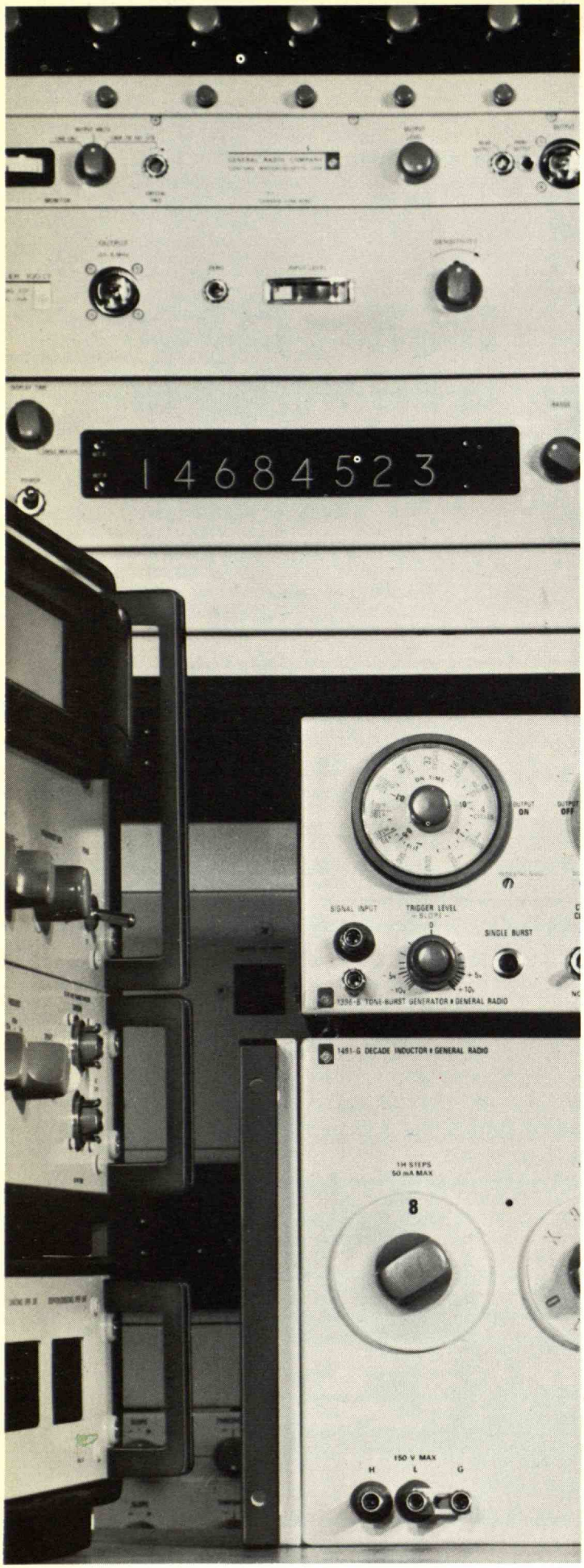

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